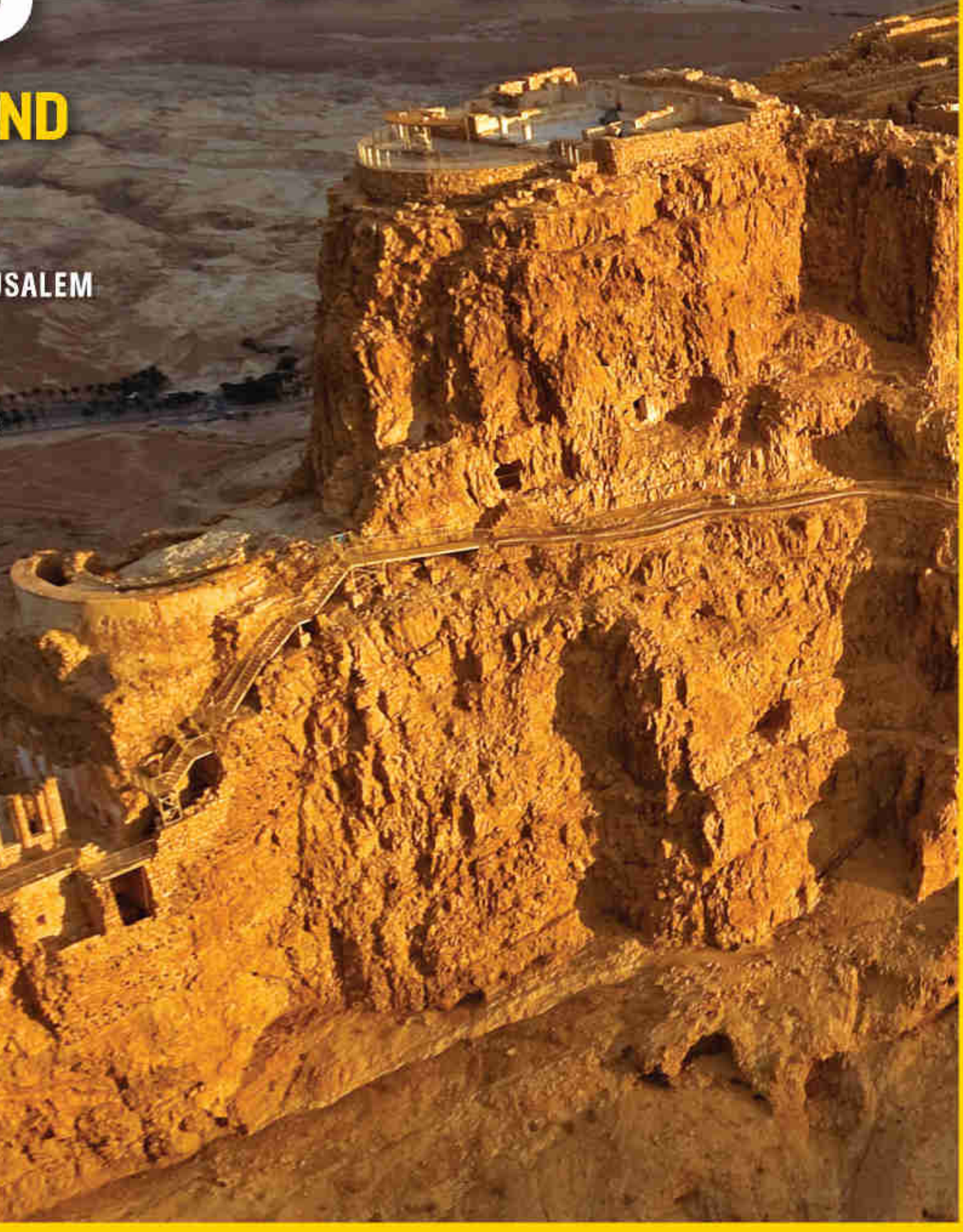
WATCH "HEROD'S LOST TOMB" ON NATIONAL GEOGRAPHIC CHANNEL

NATIONALGEOGRAPHIC.COM/MAGAZINE | DECEMBER 2008

NATIONAL GEOGRAPHIC

THE REAL
King Herod
ARCHITECT OF THE HOLY LAND

MAP SUPPLEMENT OLD JERUSALEM



NATIONAL GEOGRAPHIC

Crucible of History

THE EASTERN MEDITERRANEAN

FEW REGIONS ON EARTH can match the eastern Mediterranean for drama. Its story, written in stone and blood over five millennia, sweeps through history on the wings of empire: Egyptian, Phoenician, Hittite, Assyrian, Canaanite, Israelite, Babylonian, Persian, Greek, Roman, Byzantine Christian, Arab Muslim, and Ottoman—all ruled in this territory between the Nile and the mountains of Anatolia. Its deserts, echoing with the voice of God, seared the legacies of Abraham's faith—Judaism, Christianity, and Islam—into human history. And a quieter but vital subplot, trade, wove an invigorating exchange of goods, cultures, ideas, and people that colored every era and region.

Then there are the dramas of today, many of them written after World War I by colonial powers of Europe who occupied lands of the fallen Ottoman Empire. The Arabic-speaking peoples of the region, poor and suffering from centuries of neglect, finally won self-determination in the mid-20th century. Now they find themselves in troubled post-colonial societies torn by epic conflicts, ranging from the battles of Israelis and Palestinians over land and resources to the clash of Islam and the West.

Pathways to God

Sacred to Jews, Christians, and Muslims, Jerusalem has been a beacon of faith for millennia. Abraham's route to Canaan, as well as the path by which Moses led the Jews out of Egypt, can be reckoned from biblical accounts. The Gospels describe Jesus' final trip to the Holy City. Muhammad preached of God in Arabia and, in a vision, flew on a winged steed to Jerusalem, the city toward which he first taught his followers to pray.

THE NILE DELTA
Seat of political power for three millennia, kingdoms of the Nile often held sway over coastal lands to the northeast. The Nile Delta, a pastoral lowland in antiquity, is home to 39 million people between Egypt's sprawling capital, Cairo, and the coast.

SUEZ CANAL
A French company used Egyptian forced labor to open the 100-mile-long shipping shortcut in 1869. When Egypt nationalized the Suez Canal in 1956, armed forces of Israel, Britain, and France tried, and failed, to regain it. The canal remains vital to international cargo shipping and, along with the Sumed pipeline, makes Egypt a strategic transit point for Middle East oil.

FOUNDING OF ISRAEL
A Jewish home in the land of the ancient Israelites—the dream of European Zionists—became a reality after Britain took control of post-WWI Palestine and offered its support. Decades of Jewish immigration led to a 1947 UN plan to partition Palestine into Jewish and Arab states, which the Arabs rejected. Israel declared independence in 1948, and the first of seven Arab-Israeli wars erupted.

THE FERTILE CRESCENT
The rich soils and rain-soaked coastlands of the eastern Mediterranean form the western arc of the legendary Fertile Crescent, where agriculture was first developed around 8500 B.C.

CROSSROADS OF TRADE
Long-distance haulers of the ancient world, camel caravans were lifelines of the economy, linking Mediterranean ports such as Tyre and Alexandria to inland markets and products. Where trade routes crossed, settlements flourished: Damascus, Aleppo, Amman, Jericho.

20TH-CENTURY BORDERS
When the Ottoman Empire, allied with Germany and Austria, fell after World War I, victorious Britain and France took control of part of its territory, dividing it into colonies that later became the nations of Syria, Lebanon, Jordan, Israel, and Iraq. Egypt was a British protectorate until 1922, Cyprus a British colony until 1960.

DEAD SEA RIFT
This extension of the Red Sea Rift formed as Africa and the Arabian Peninsula parted; its seismically active faults run through the Gulf of Aqaba into Syria. The rift cradles critical—and contested—water resources, the Jordan River and tributaries and aquifers that underlie the West Bank.

RISE OF ISLAM
A revelation of God's word transformed an unlettered merchant from western Arabia into the Prophet Muhammad. After his death in A.D. 632, followers carried his message north as an army of conquest, moving into the lands of the Christian Byzantine Empire. Today Muslims make up the vast majority in all eastern Mediterranean countries except Israel, Lebanon, and Cyprus.

CYPRUS
War divided Cyprus into a Turkish Cypriot north and a Greek Cypriot south in 1974; UN forces patrol the cease-fire line. The Turkish Republic of Northern Cyprus is not internationally recognized, so Turkish Cypriot place-names are in parentheses.

GOLAN HEIGHTS
Israel took the Golan Heights from Syria in 1967. The population of 40,000 is almost evenly divided between Jews and Arabs.

WEST BANK & EAST JERUSALEM
Jordan lost the West Bank and East Jerusalem to Israel in 1967. An estimated 466,000 Israeli settlers live alongside more than 2.4 million Palestinians.

GAZA STRIP
Israel captured the Gaza Strip from Egypt in the 1967 Six Day War, and withdrew its settlers and forces in 2005. Some 1.5 million Palestinians inhabit this densely populated land.

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0 25 50 STATUTE MILES

Land Cover Some areas are mixtures of land cover types.
Population · Oil Pipelines · Railroads · Roads · Cropland · Grassland · Shrubland · Bare Ground

Map Legend
- Archaeological site
- International airport
- National capital
- Water hole
- Oil field
- Dry lake or wash

City Population

AMMAN	More than 1 million
Jerusalem	100,000 to 1 million
Paphos	25,000 to 99,999
Tāba	Fewer than 25,000

Geographic Terms
Bir, Bi'r: spring or well
Burnu: cape or point
Qā': depression
Qaşr: castle or fort
Rās, Ra's: cape or point
Wādi, Wādī: riverbed or valley

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Red-breasted Goose *(Branta ruficollis)*

Size: Head and body length, 53 - 56 cm (20.9 - 22 inches); wingspan, 84 - 87.2 cm (33.1 - 34.3 inches)

Weight: 1.1 - 1.6 kg (2.3 - 3.6 lbs)

Habitat: Nesting habitat is tundra; forages for food in land cultivated for grain, pastures and natural grasslands

Surviving number: Estimated at 37,300

Photographed by Andrey Zvoznikov

WILDLIFE AS CANON SEES IT

How do you outfox a fox? The red-breasted goose sometimes manages to foil its old adversary, the Arctic fox, by nesting near the peregrine falcon. The falcon repels approaching foxes, which makes a safer home for the goose. Having a bodyguard is especially useful in the summer; geese arrive at their breeding grounds in June as the snow melts, nesting in colonies of five to six pairs, and the new families are particularly vulnerable until the chicks fledge. But foxes aren't the only threat to the goose; faced with hunting, habitat loss and recent reductions in winter wheat, survival has never been trickier.

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NATIONAL GEOGRAPHIC

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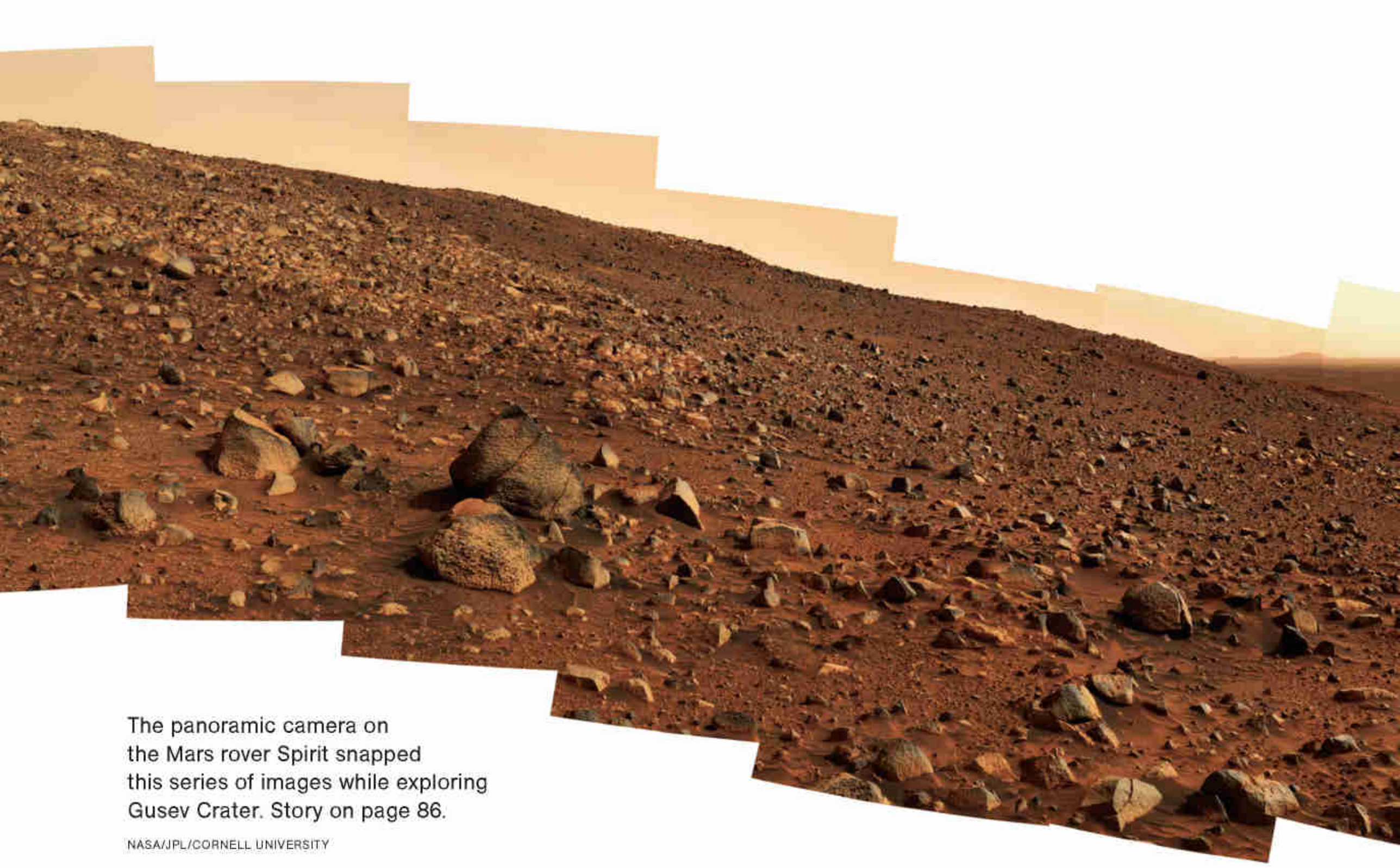

The panoramic camera on the Mars rover Spirit snapped this series of images while exploring Gusev Crater. Story on page 86.

NASA/JPL/CORNELL UNIVERSITY

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY

NATIONAL GEOGRAPHIC

DECEMBER 2008

HISTORY

Words to Honor

The Declaration of Human Rights turns 60.

WILDLIFE

Father Knows Best

Male seahorses and rheas are hands-on dads.

HEALTH

On the Blink

What goes on when your eyes wink shut.

CONSERVATION

Chain Saws vs. Butterflies

Monarchs are losing a Mexican migratory rest stop.

FOSSILS

Sea Rex

A fresh pliosaur fossil is as big as a school bus.

ENVIRONMENT

Trash Register

Every piece of highway litter tells a story.

On the Cover

Herod's palace known as Masada, Hebrew for "fortress," overlooks the Dead Sea.
Photo by Michael Melford

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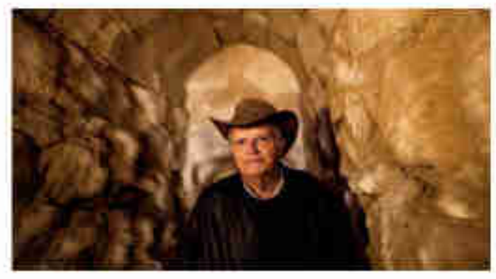

Tomb Seekers
Watch archaeologist Ehud Netzer (above) explore the monument where King Herod was buried. Listen to Michael Melford talk about his photos for the story.

MICHAEL MELFORD

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AN AMERICAN REVOLUTION

EDITOR'S NOTE

Alfred Russel Wallace called *Trogonoptera brookiana* (left) "perhaps the most elegant butterfly in the world."

I once met a hunter in British Columbia who could read a trapline as if it were a novel. Where others saw merely trees, scrub, and earth, he could interpret the wanderings of foxes, deer, and lynx. He was a man who did more than look. He could see.

Alfred Russel Wallace, the almost Darwin, was such a man. Without benefit of formal education, Wallace, a young English field biologist and collector of exotic species, described a theory of evolution that paralleled one Darwin had developed but hadn't yet published. What lifted Wallace from the realm of the ordinary, points out David Quammen in this month's story, was his extraordinary capacity to observe, a skill honed in his early days as a land surveyor, during long walks across the Welsh moors. It helped that Wallace, on his monumental expedition to the Malay Archipelago, collected specimens in multiples. One might construct a sentence from one golden birdwing butterfly. Given 50 golden birdwings, Wallace could construct a story. Another naturalist might not note ever-so-slight variations in size, color, and pattern. Wallace did. He not only saw, he meticulously recorded his findings, then connected the dots. Of such stuff is great science made.

"Learn to see," said the eminent 19th-century physician William Osler. Before the advent of sophisticated medical imaging like MRIs, Osler could diagnose a complicated disease simply by noting subtle signs visible to the eye. To be able to see, not merely look, is the foundation of discovery.

PHOTO: ROBERT CLARK; PHOTOGRAPHED AT SOPHIA M. SACHS BUTTERFLY HOUSE, MISSOURI BOTANICAL GARDEN

night night. lights out. hey this thing goes all the way flat. now i can sleep on my side. on my other side. on my - what's this? a duvet? what's a duvet? i don't know but man it's soft. and this pillow is plush. did i just say 'plush'?

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NATIONAL GEOGRAPHIC

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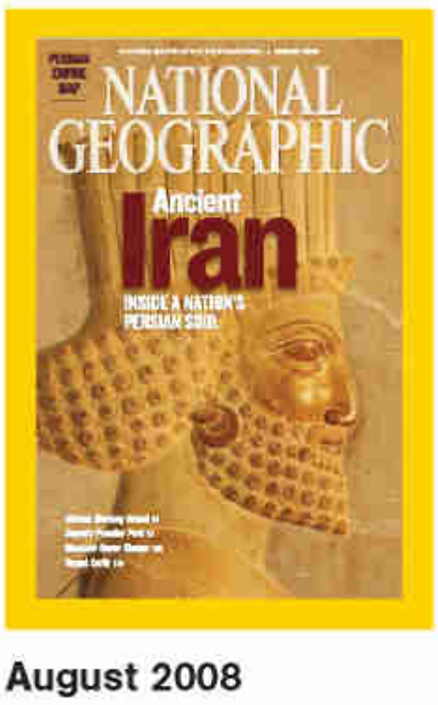
LETTERS



August 2008

Persia: Ancient Soul of Iran

Persian history is woefully absent from school curricula and places Americans at a great disadvantage in comprehending developing world events on our own, rather than relying on the agenda-driven media. All Americans should be aware of the Cyrus Cylinder that professed individual rights 3,000 years ago. A superpower that forbade slavery, permitted religious freedom, and united far-ranging empires in spite of significant cultural differences merits our admiration and study. Was Cyrus, that great leader, studied by the framers of the U.S. Constitution?

AL BARRERA
Brownwood, Texas

Author Marguerite Del Giudice's interpretation of the Cyrus Cylinder is somewhat controversial. Some scholars believe that Cyrus was not unique, but part of a Mesopotamian tradition dating back to at least the third millennium B.C., in which the conquering kings would proclaim their greatness before their new subjects. The claim that Cyrus "banned slavery and oppression of any kind" is based on a possibly biased translation of the text. A more faithful translation would suggest that Cyrus did not force those who were free men before his conquest to become slaves of their new Persian overlords. Those who were already slaves probably remained as such under Persian rule. The idea that Cyrus emancipated slaves is highly doubtful. Furthermore, the assertion that the Persians "gave member states the right to subject themselves to Cyrus's crown, or not" is also highly suspicious. Cyrus the Great was a remarkable leader, but it is important not to exaggerate the interpretation of the historical account. He and his empire were far more complex than they are usually portrayed in popular history, both in the West and in his homeland of Iran.

ADRIAN ION
Stanford, California

Persia's power flowed from ideas. Persia's religious tradition originated concepts about a future messiah as well as notions of good and evil, free will, final judgment, and heaven and hell. The geography of Persia made it a gateway for the exchange of ideas between East and West. Persia was a harbinger of human rights. It is ironic that Iran does not honor this heritage in its treatment of minorities during modern times.

DOUG A. COUPER
Milton, Ontario

The Iranians seem to have a great duality of religion mixed with a culture composed of wisdom, beauty, and love. Thank you for exploring a people who have been denigrated so much, and showing me that acts of a few do not represent an entire people.

DAMON HILLMAN
Hoover, Alabama

The timing couldn't be more perfect in bringing coverage to the past and the present of Iran. With the current administration trying to blind citizens with rhetoric on Iran to satisfy its thirst for oil—yet again, under the pretense of freedom and security—this could be an eye-opener for everybody. Lessons about other cultures are very important to our kids, helping them appreciate other nations and nationalities when they grow up. Remember, all of our kids are potential officeholders tomorrow.

RAJESH ANANTH
San Jose, California

I was a foreign exchange student from the U.S. to Iran in 1968. My host family welcomed me as a daughter. They were loving and wonderful people. However, they disappeared after the Islamic revolution, and I never heard from them again. Great civilizations are defined by the fiber of their people. Their demises are defined by inflated egos. I fear that Mahmoud Ahmadinejad will take his country down a path of destruction.

KATHLEEN AMEN WAZNY
Denton, Texas

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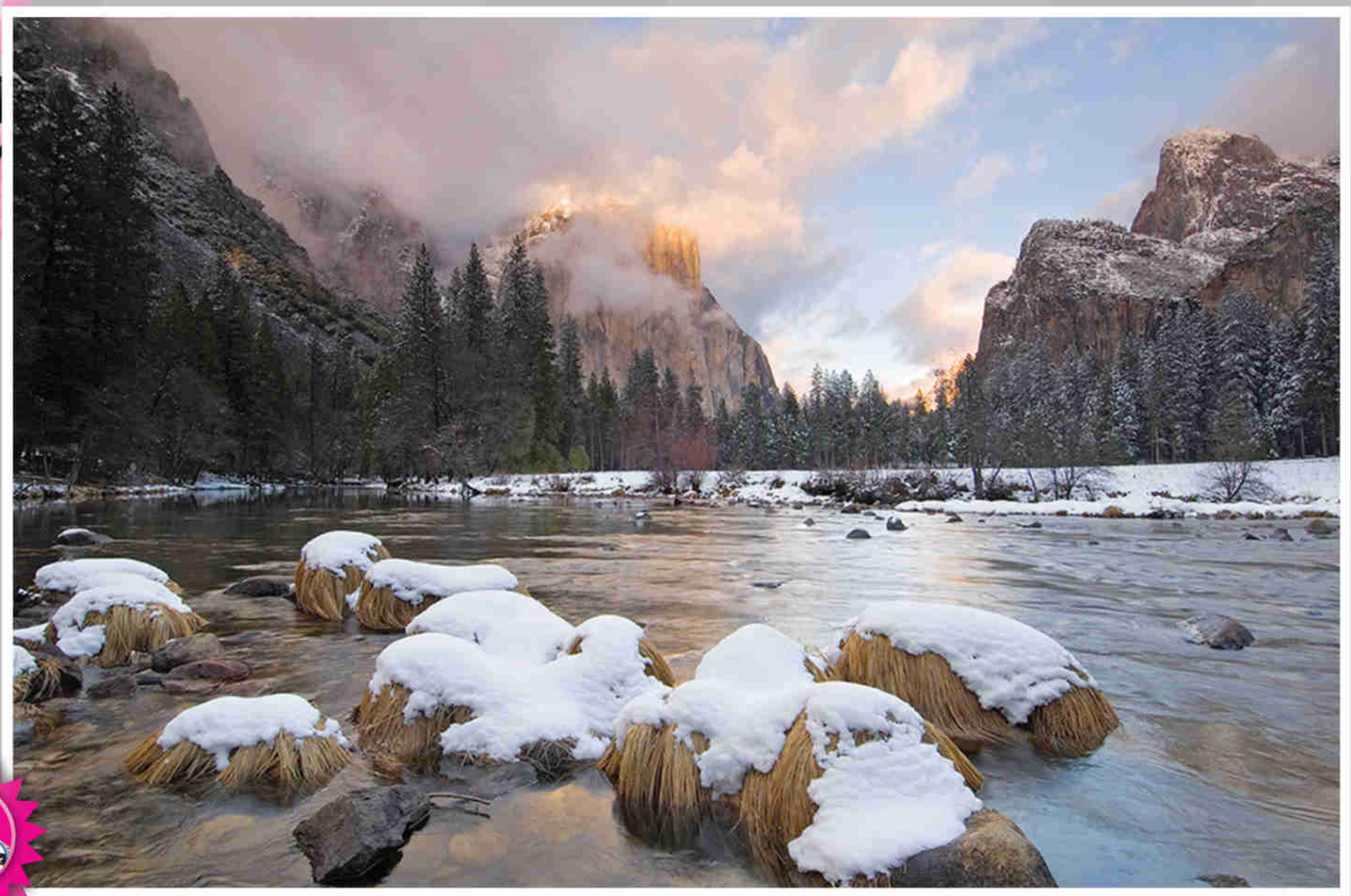

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— Jim Richardson, internationally acclaimed photographer with *National Geographic* magazine and judge in the Energizer "Ultimate" Photo Contest

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LETTERS

As an Iranian-born U.S. citizen, I found your article insightful and balanced. A parallel can be drawn regarding the CIA-backed coup of 1953 (which quelled a true democratic movement, resulting in all of the current geopolitical issues at hand) and the injustices in our own history against blacks, Japanese Americans during World War II, and American Indians. Until we acknowledge the past wrongdoing in Iran, we cannot set the right course for the future, pursuing a peaceful world. We must remember that a prime motivator of a terrorist is the historical injustices against his or her nation. One man's terrorist is another man's freedom fighter. It is up to all of us to take a deep, painful look and correct our course. Would our next generation take up arms in retaliation if a foreign intelligence agency overthrew our current government to secure cheap supplies of coal?

HOOMAN SHADRAVAN
West Hills, California

Thank you for showing us a country quite different than the one portrayed by other media. It's sobering to think that if the United States had thought more strategically in 1953, Iran could be our ally. Short-range thinking focused on oil interest and paranoia about communism failed the long-term interests of our nation. We need to study Iran and learn more.

JOHN L. DUNHAM
Dayton, Ohio

Moscow Never Sleeps

I want to congratulate *National Geographic* for two reasons. First, this article has haunted me ever since I read it. It would seem that Moscow is experiencing one of those rare and exhilarating moments in history when everything and nothing is possible at the same time. Second, as a long-term subscriber, I have noticed that on those occasions when a novelist or poet writes one of your articles, the result is a wonderful marriage of imagery and images. Please keep this up, because you have shown that a few words by a good writer can be worth more than a thousand pictures.

BOB TAYLOR
Natick, Massachusetts

The article left one with the impression that every Muscovite is either a drunk or a billionaire drunk. It is apparent that the author sought to report on the worst features of the city and its inhabitants.

I just returned from a month in Russia. There is far more to life there than seamy nightlife, billionaires, and corruption. You failed to mention the happy families strolling in Red Square, or the presence of Korean, Nigerian, and other foreign students who have found Moscow an excellent place to pursue an education. The beautifully appointed metro station that you dubbed a Soviet-era monument to the noble proletariat, now filled with "harried capitalists," represents freedom and affordable transportation to thousands of citizens, many of whom now own their own businesses. If your reporter had found good-hearted interpreters, stayed in private homes, and listened to personal stories of people who survived Stalin's prisons instead of frequenting nightclubs, your article would be vastly different.

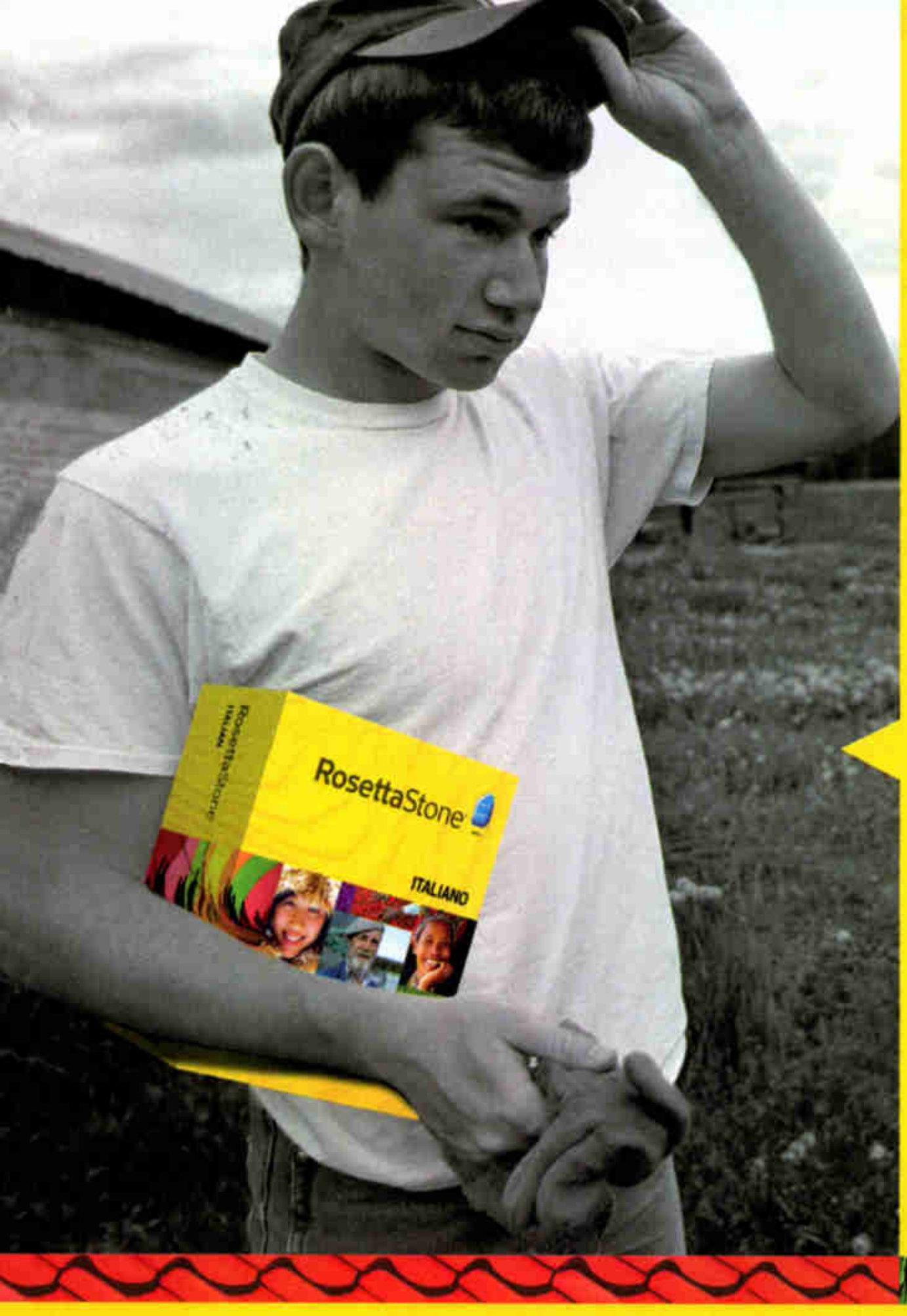
SHARON KLEINSCHMIDT
Texarkana, Arkansas

The article left one with the impression that every Muscovite is either a drunk or a billionaire drunk. It is apparent that the author sought to report on the worst features of the city and its inhabitants. We had returned from Moscow just two weeks before reading the article. We saw a city that was vibrant, clean, and beautiful, populated by hardworking, fun-loving, average people. We saw no motorcycle gangs, drunks, or bad behavior—but then we did not carouse in back alleys and drug dens. The two photos that show Red Square indicate there is something sinister about it. There is not! This report could have been about any big city, worldwide.

THOMAS A. GEISLER
Hayward, California

Corrections, Clarifications

August 2008:
Persia: Ancient Soul of Iran
Page 49: The statement attributed to the Cyrus Cylinder—"I never resolve on war to reign"—has been discredited by scholars as a 20th-century addition.



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Dog Days We've gone to the dogs. Check out the new My Shot Dogs section on *ngm.com* to find a user-submitted photo gallery, plus dog wallpaper, jigsaw puzzles, and a match game. Log on to My Shot to submit a picture of your pooch, and it might be included in an upcoming National Geographic Animals feature. For guidelines and more information, go to *ngm.com/myshot/dogs.*

Meaghan Davidson London, Ontario

The morning after a rainy night, Meaghan Davidson, 18, wandered through her uncle's garden and noticed this bent-over poppy. "I was curious to see what it looked like from underneath," she says, "so I took a picture."

Mark Duffy Moose Jaw, Saskatchewan

"The Saskatchewan prairies offer skies that go on forever," says Mark Duffy, a 52-year-old portrait photographer who captured a storm and the "inevitable rainbow." This photo was voted an *ngm.com* audience favorite.

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BELIZE

MOTHER NATURE'S BEST KEPT SECRET

For the Love of Pictures

Shortly after eight in the morning, *National Geographic* senior photo editor Susan Welchman dashes into her office, stirring a cup of oatmeal. She's hungry for more than breakfast. She launches her computer and lowers the window shades. On-screen the latest Your Shot submissions pop up: "158 today," she says.

Since Your Shot debuted in March 2006, readers have submitted more than 100,000 digital photos. Of those, the magazine has published an even hundred and put hundreds more online. All were first vetted by Welchman, who reviews new entries each morning, marking favorites with the speed of a camera's shutter. "Oh man, look at this," she says, laughing as a photo of cat food appears. "I love that one!" Bugs, birds, butterflies—lots of butterflies—rainbows, lightning, children playing, a boarded-up door.

In 16 minutes she's cut 158 shots to 12—the Daily Dozen slated to appear on *ngm.com*. "It's a big responsibility, but I love editing Your Shot because it's so real," she says. "It's rewarding to see what people are drawn to." *—Oliver Uberti*

▲ **Create mystery** "Having fun with my daughter," noted the caption. Photo editor Susan Welchman still wonders what they were doing: "I love to look through pictures and think of the people who shot them."

▲ **Look for design** In this shot the woman's white coat and the white beam pair perfectly with the blue of her glasses and the blue of the sky.

Secrets of Selection

The popularity of digital cameras has opened up the world of photography. "People are liberated from film," says Welchman. "You never have to worry about changing it or running out. You can take a picture of anything at any time." And people do. "Some shoot two inches from their face. Some shoot things far away. Others look for design and order." All are welcome in her Daily Dozen, where risk, play, and personality matter more than technique. Welchman encourages photographers to "always wear your camera around your neck" and to "go off by yourself, listen, and watch." Here are some of her favorite images and thoughts on why she picked them.

▲ **Go minimalist**
It's an odd crop, but the most important part remains: her eyes. What you like in a picture depends on where in the frame the photographer put the subject.

▼ **Capture peak action**
This photo was split seconds from being ordinary. Three dress shirts were hung to dry on a line in Ireland. Then the wind picked up, filling them as though with invisible businessmen.

Don't be afraid of the dark
Turn off your flash. Grab a tripod. Crank your ISO setting to 3200 or higher. Even if you think it's too dark, try it. With digital, what have you got to lose?

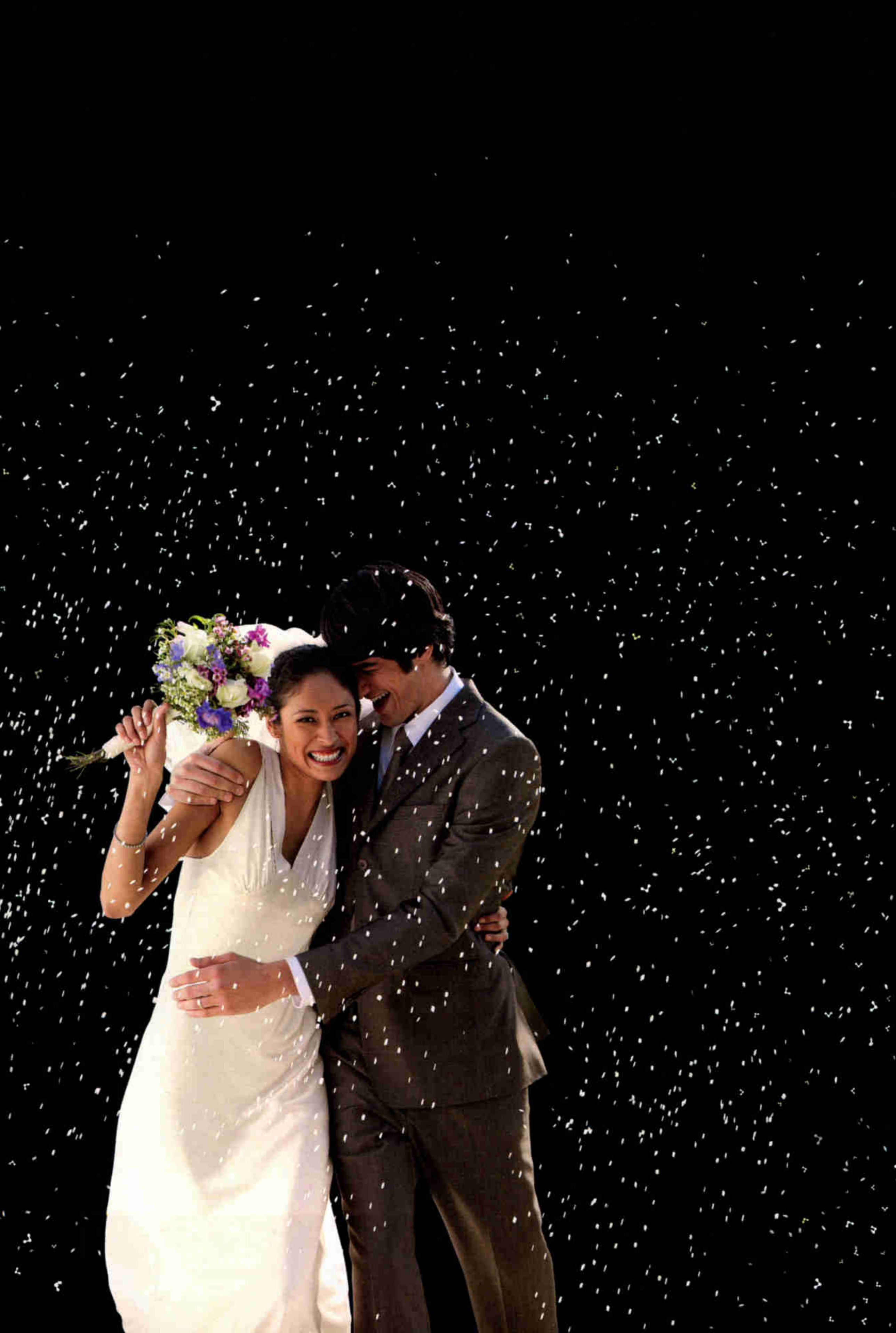
Avoid the silhouette gimmick
A silhouette can be nice as one part of a picture. But when it's the only thing, it almost never works.

▲ **Find irony** Three-quarters of the image is out of focus, but balanced by the sharpness of the metal dog in the foreground. It's funny, but beautiful.

Personalize your captions
I look at photos, then the captions. If I can sense something about a person from their words, I like that.

▲ **Save your happy accidents**
Memory cards can store thousands of photos, so don't delete your "mistakes." This photographer probably did not intend to have this girl's ribbon blow across her face. Yet the flaw makes the frame.

PHOTOS (CLOCKWISE FROM FAR LEFT): TZVETELINA IANEVA; WERONIKA MACIOSZCZYK; BRUCE BENEDICT; JOSÉ LUIS MARQUÉS; ROBERT F. BERGMANN; ANA VILORIA



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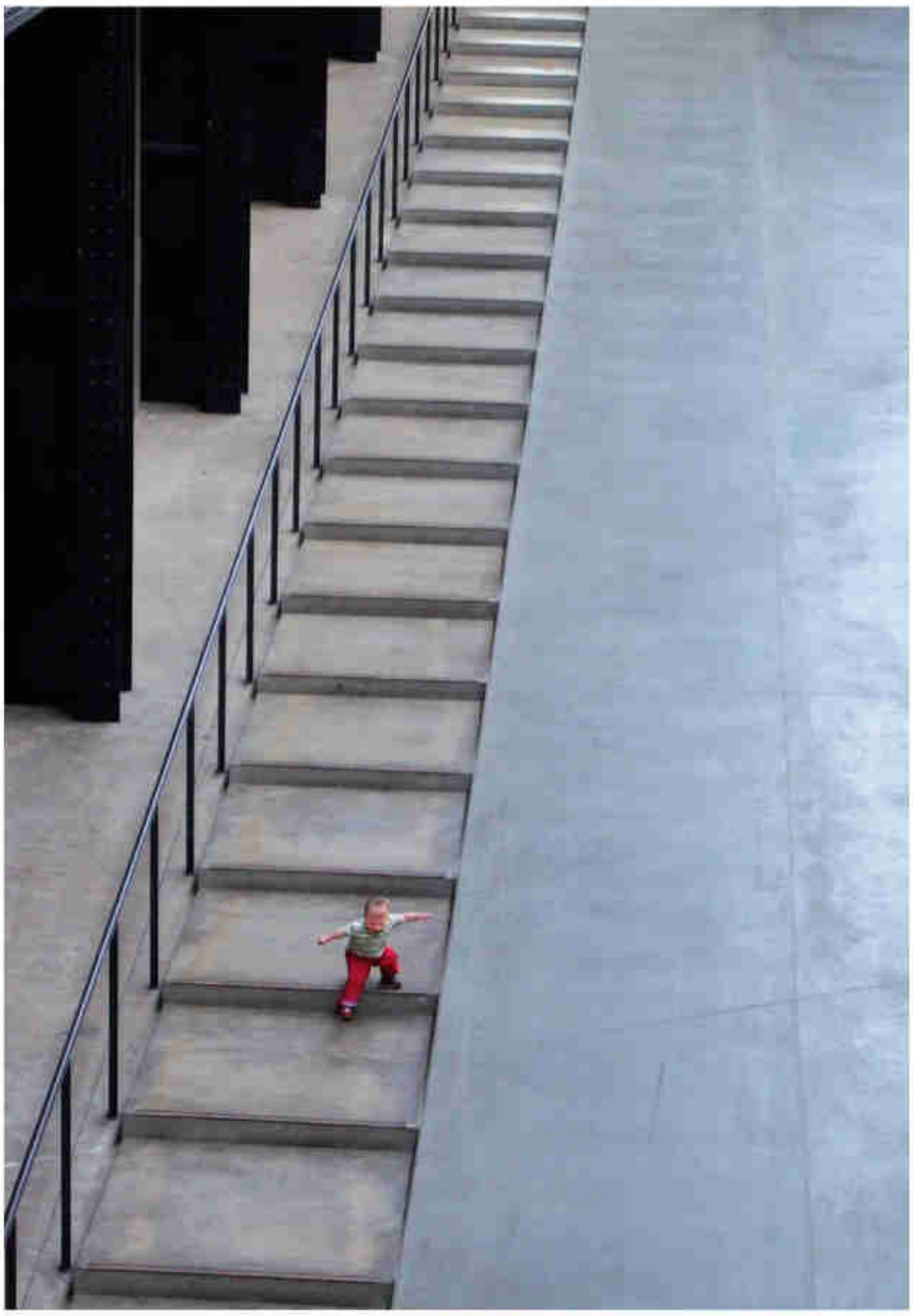


Anticipate the Moment

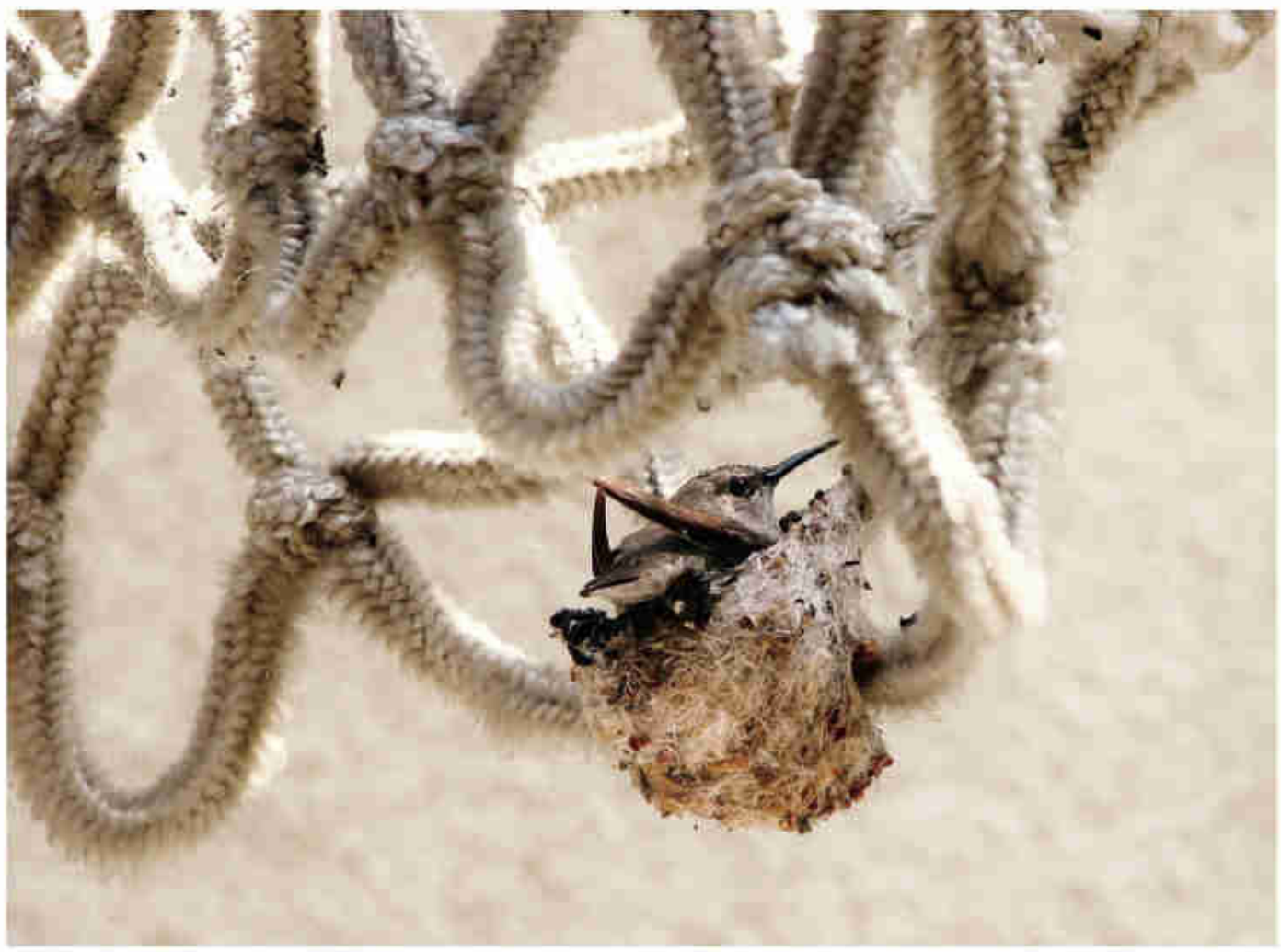
The best photographers often visualize their pictures before the magic moment occurs. Longtime *Geographic* contributor William Albert Allard has been known to shoot dozens of frames of a street corner even though nothing seems to be happening there. "I'm waiting for something," he says, "but I don't know what."

If you find a place you like that has good light or terrain, "park yourself," suggests Welchman. "Then wait for something to come into the frame." It's a trick for any location: on the steps of London's Tate Modern (left), in the wild, on an Italian crosswalk (below), or underwater. "You're like a human camera trap."

Challenge Clichés

Did you get a new camera for the holidays? Put it to use by finding fresh ways to look at family, friends, even the animals in your own backyard.

Welchman gets photos of frogs, insects, and birds every day. The key to photographing local wildlife is to find the rare instances and odd vantage points that turn clichés into classics. Here the photographer snapped a hummingbird nest built in a basketball net. "It makes you nervous," Welchman says. "Like it's going to blow away."



PHOTOS (CLOCKWISE FROM TOP): LE PHAM; SLAWEK OLZACKI; RENEE GOBEY

With energy costs and oil dependence on the rise, *the need for renewable power is greater than ever. That's why Waste Management is using the resources at our disposal to create the energy equivalent of saving over 14 million barrels of oil per year. It's a powerful idea we're proud to drive forward.*

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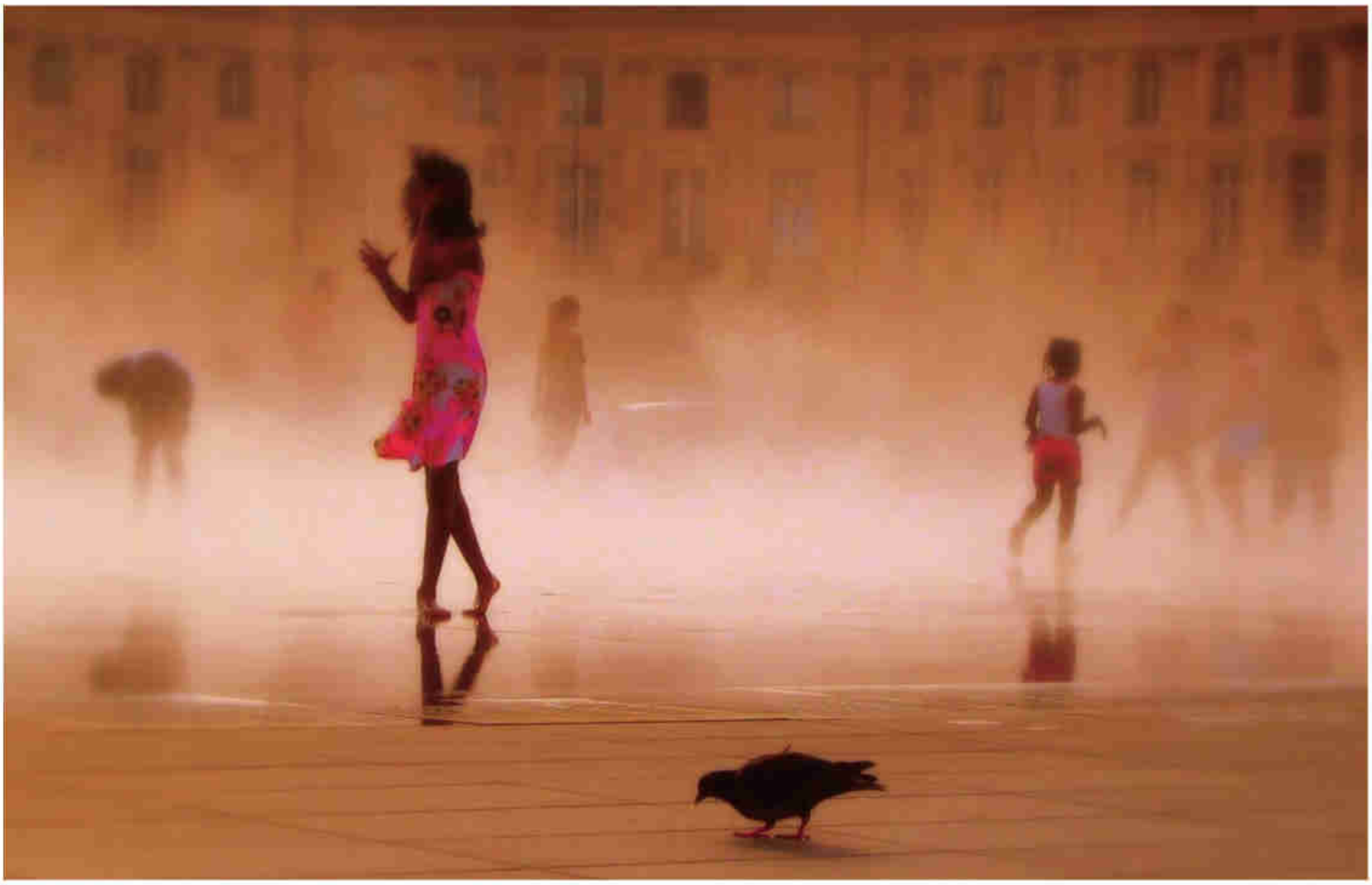

Take Us Somewhere This shot's limited color palette and painterly composition caught Welchman's eye. She showed it around. One editor saw a young woman shielding her eyes from a sandstorm. Another imagined tourists caught in a steamy downpour. In truth, it shows children cooling in the mists of a fountain in Bordeaux, France. "Not a lot of facts here," notes Welchman, but as with many of her favorites, "there's a lot of room to dream."

Setting your digital camera to black-and-white can simplify somber moments. "Black-and-white organizes the eye," says Welchman.

See for Yourself

Digital photography encourages experimentation. Try shooting a favorite subject without looking through the viewfinder. The results may surprise you. "In Your Shot," Welchman says, "we want to see originality. We want to see the places we can't assign, places only available to you."

So to make the Daily Dozen, the best approach is to trust yourself. "Shoot photos that you'll want to save forever for the stories they carry." Chances are she'll want to save those too.

PHOTOS: LINDSAY LOEBIG (TOP); ERNEST REX

These are hardly the times to pay for more power than you need

Doesn't last longer in most common household devices

Costs More

More power than most of our devices need

Excessive

Lasts just as long in most common household devices

Costs Less

The best value for 90% of our devices

Efficient

Don't waste power.
Don't waste money.

DURACELL
TRUSTED EVERYWHERE

Pale Male (at left) arrived in New York City in 1991; now as many as 50 pairs of red-tailed hawks nest there.

Lincoln Karim has spent a decade photographing red-tailed hawks and other wildlife in New York City.

Enraptored The red-tailed hawk, unfurled like an exotic kite, carves silent spirals over Central Park, riding currents of summer air boiling up from the city. Soon the bird alights on the cornice of an ornate apartment building, surveying the swath of New York City it has claimed as its own. Such sights inspired Lincoln Karim to become Gotham's most ardent hawk-watcher. Let's be clear, he emphasizes, the land belongs to the hawks. "The building may be owned by Donald Trump or some Wall Street billionaire, but every squirrel or songbird in the area knows it's the hawks' domain."

Karim spends most mornings and evenings photographing near hawk nests scattered throughout the city. He gained brief notoriety for protesting efforts by an exclusive Fifth Avenue co-op to evict the city's most famous mating pair, Pale Male and Lola. Though he prevailed, one magazine ranked him among most-hated New Yorkers. "I don't care," he says. "When I see a hawk fly over me, I want to fall down on my knees, because it's so beautiful and powerful and truly wild, and it's living among us in this crazy city."

BOTTOM PHOTO: IRA BLOCK

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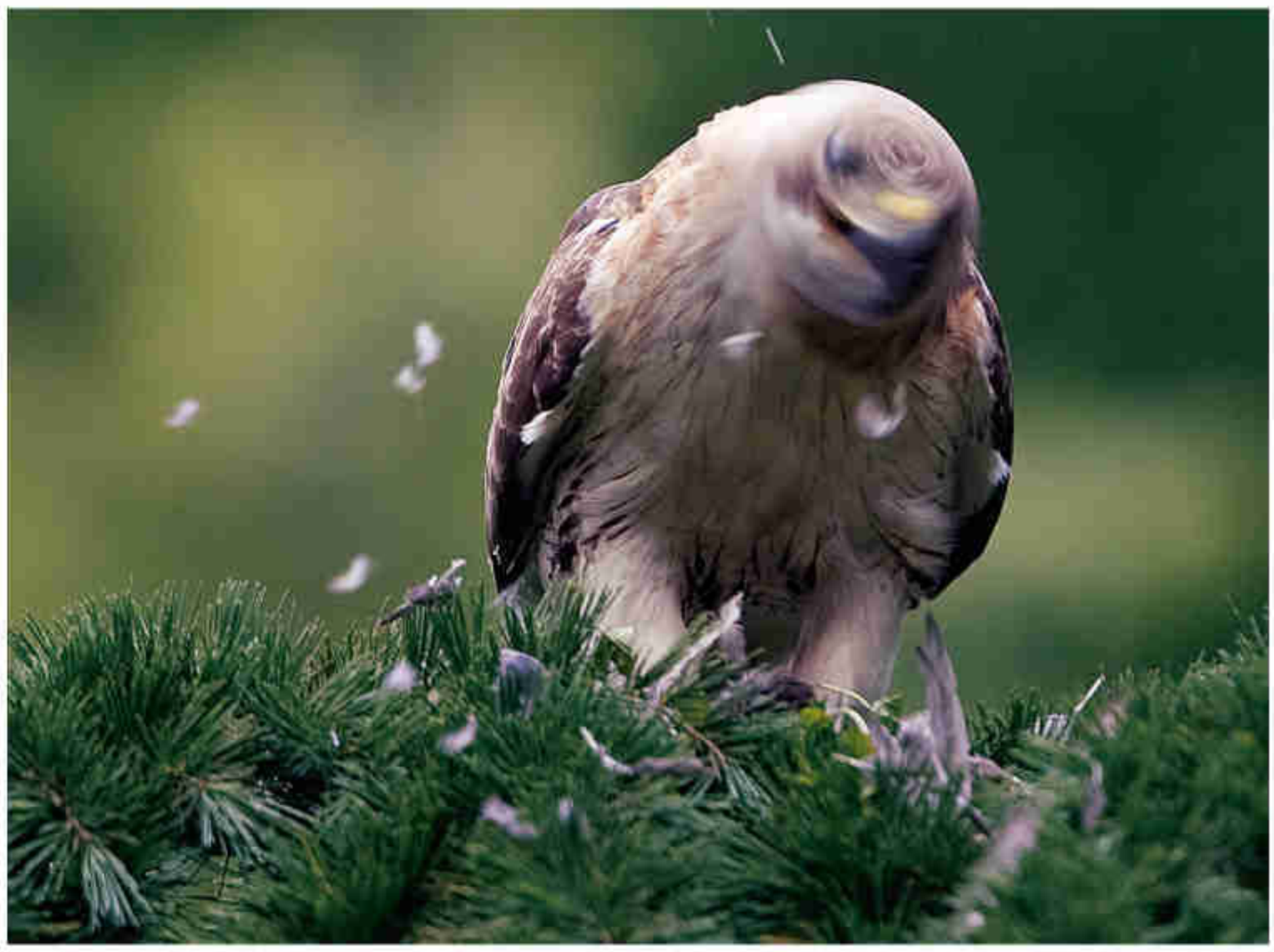
PHOTO JOURNAL | LINCOLN KARIM



His head a blur, Pale Male shakes bits of food from his beak. Red-tailed hawks have long migrated through New York, but the city's bird-watchers think Pale Male is the first on record to make his home in Manhattan. He is believed to have had four mates, with which he's produced numerous chicks. He and current mate Lola live on a 12th-floor ledge overlooking Central Park.

Seven-week-old Little Stinker, a descendant of Pale Male, finds a quiet spot. After hatching near the tops of skyscrapers, fledglings face steep first flights. Karim watched as Little Stinker plummeted from his 34th-floor nest. Animal control captured the disoriented hawk and soon released him in Central Park.

COUNTRY OF BIRTH ❤ FRANCE
MOTHERLAND ❤ INDIA

Anne Chaymotty always wanted to be a dancer. In her formative years, she was nurtured in classical ballet in Paris. Her search for the perfect art form came to an end when she discovered Bharat Natyam – one of the world's oldest dance styles. The complexity, beauty and spiritual power of this 3000-year-old classical dance came as a revelation to her and became her first love. Today she is known as Devayani, one of the foremost exponents of Bharat Natyam in the world. If you are seeking peace and fulfillment, visit India. Like Devayani, you will find that your search ends here.

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PHOTO JOURNAL | LINCOLN KARIM

Harassed by an angry grackle, Pale Male returns to his nest grasping a pigeon he killed near the Metropolitan Museum of Art. The hawks' favorite meals, says Karim, are rats, pigeons, and squirrels. In spring the hawks will also raid the nests of grackles and robins, devouring their young.

An antenna offers the perfect perch from which to spot prey, low-flying helicopter notwithstanding. Red-tailed hawk numbers are growing at a time when urban sprawl seems to be claiming much of their natural habitat. Increasingly, the birds are adapting to the city, which offers plenty of food and places to nest.

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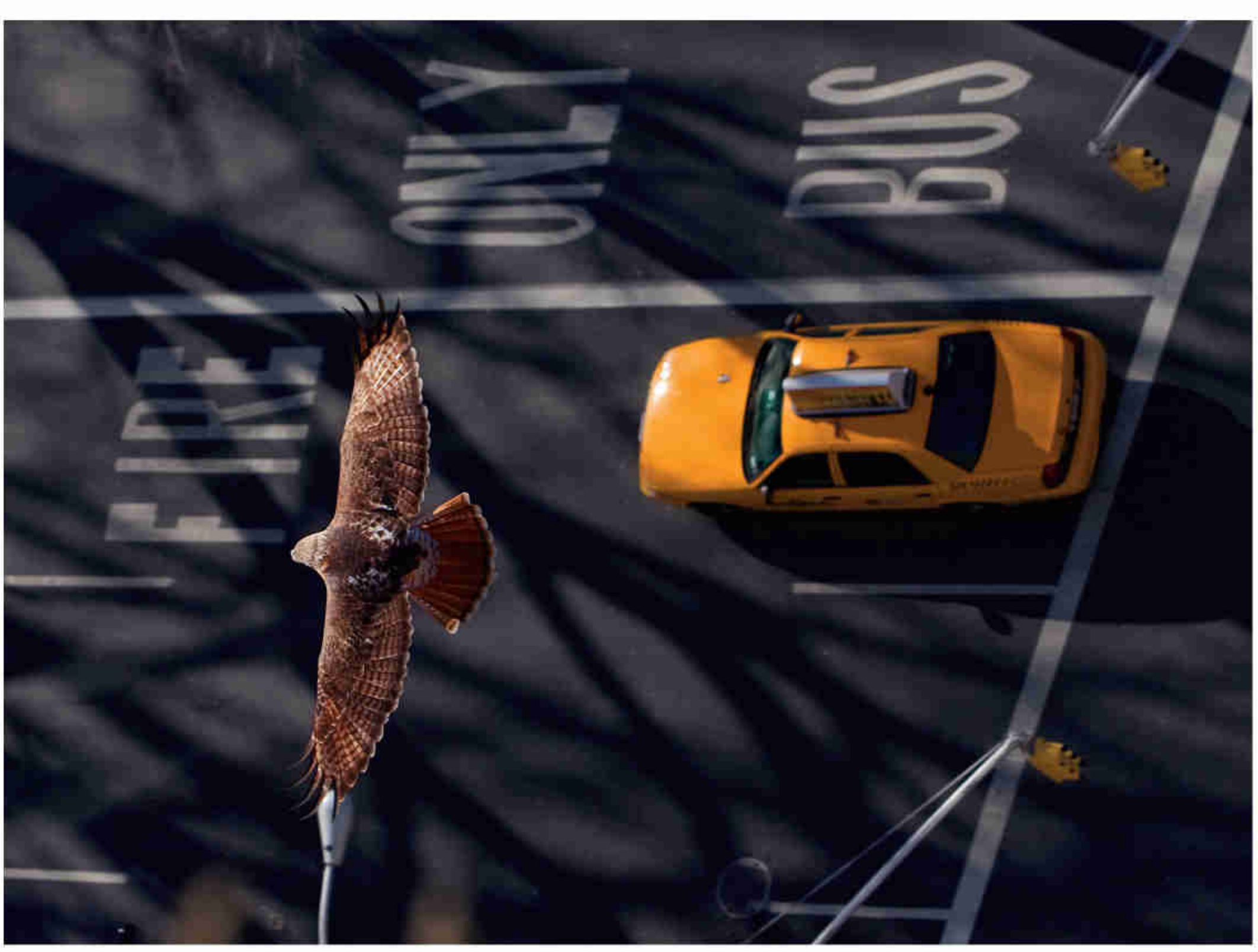
PHOTO JOURNAL | LINCOLN KARIM

A hawk wears a numbered band applied by a wildlife rehabilitator to help study raptors. "I am strongly against banding," says Karim, noting the distress a bird endures during the process. "I wish people paid more attention to things we know are killing hawks, such as the proliferation of rat poison."



Most New Yorkers are oblivious to the hawks gliding above them, says Karim. "They're hunched over cell phones or busy hailing cabs. But kids see them. That's why I always let them look through my lens at the nests and give them copies of my photos. Kids in the city today are my hope for the hawks' future."

Saab XWD lets you get the most out of your adventures:

FOOD: Hudson's on the Bend serves a tasting menu strong on wild game (elk, venison)—yet offers tamer options. Frequent guests start with an order of rattlesnake cakes. *3509 Ranch Road 620 N; www.hudsonsonthebend.com/main.php*

MUSIC: Fans of country, blues, jazz, rock, hip-hop, you name it—find clubs to suit their taste downtown. Austin's live entertainment district occupies *East 5th to 7th Streets and Congress Avenue to Interstate 35. www.6street.com*

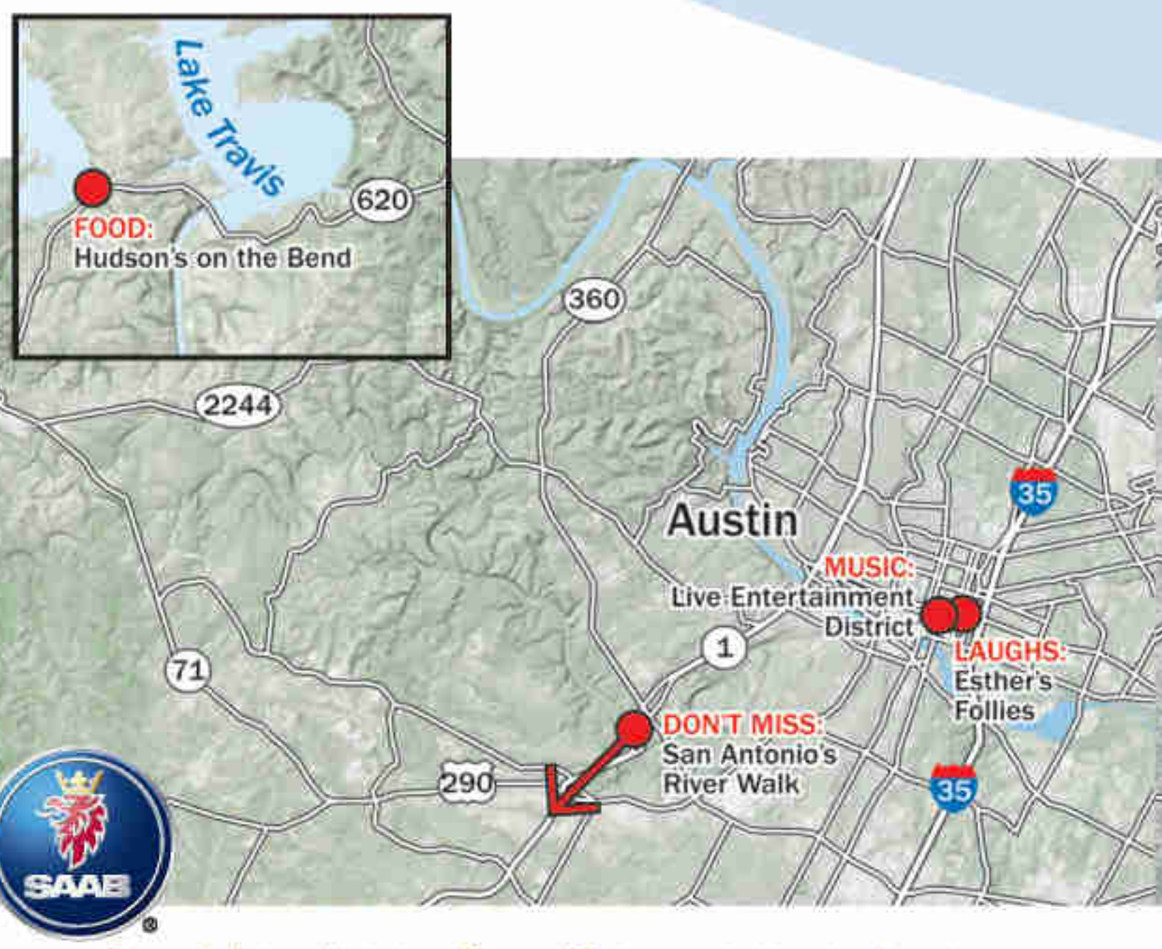
LAUGHS: Madcap improv, leavened with a drop of magic and a dollop of vaudeville, are the recipe for fun at Esther's Follies, which has been keeping Austin in stitches for 25 years. *525 East 6th Street; www.esthersfollies.com*

DON'T MISS: Strolling mariachi bands on San Antonio's vibrant River Walk (about 80 miles from Austin) serenade café customers, and sightseeing barges ply the river, which flows down to the Gulf of Mexico. *www.thesanantonioriverwalk.com*

MUSEUM: Devoted to the 36th U.S. President, the LBJ Library and Museum displays historical and cultural exhibits. Its First Lady's Gallery adds a personal touch, sharing her love letters and Johnson family home movies. *2313 Red River Street; www.lbjlib.utexas.edu*

SIDE TRIP: Head to scenic Texas Hill Country, where you can explore underground caverns, see how the earliest Texans lived, pick a bouquet of Texas bluebonnets, even saddle up at a dude ranch. *www.austinchronicle.com/gyrobase/Guides/HillCountry*

LANDMARK: Back in 1837 at the Alamo in San Antonio, heroic Texas soldiers fought off Mexican forces for twelve days, but ultimately succumbed. Today the 4.2-acre complex is an official state shrine. *300 Alamo Plaza; www.thealamo.org*



For additional cities, Cross Drive activities in Austin, and to submit YOUR OWN experience log onto:
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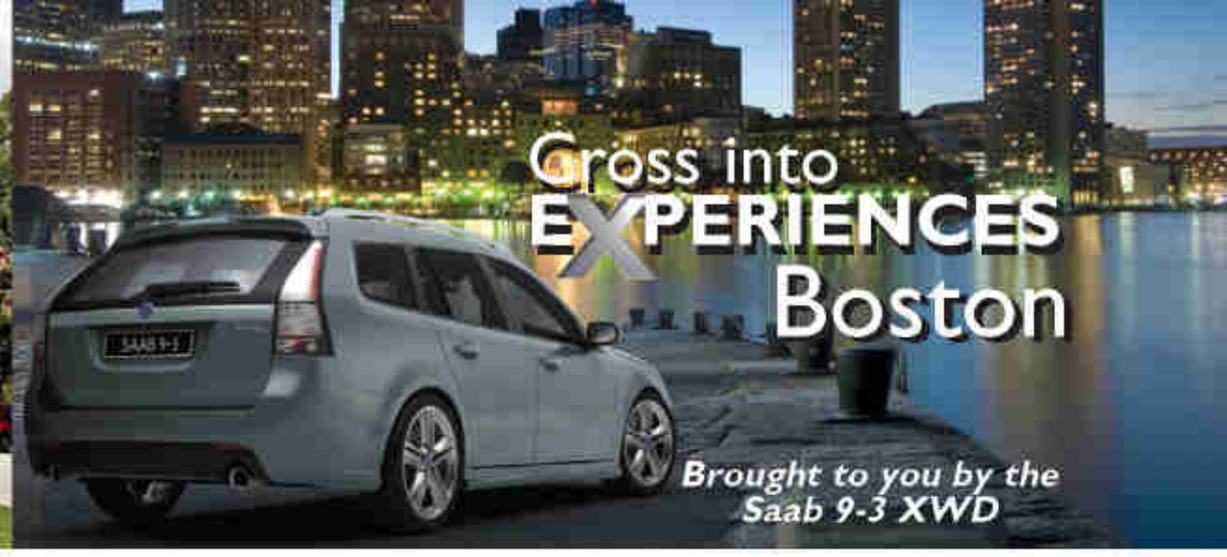


Saab XWD lets you get the most out of your adventures:

FOOD: Neptune Oyster casts a wide net to satisfy seafood lovers with favorites such as chowder, oysters, and lobster. It also tempts palates with delicacies such as fresh sardines and octopus, prepared in novel ways. *63 Salem Street; www.neptuneoyster.com*

MUSIC: Hear works by Mozart and Mussorgsky, Dvorák and Debussy, and other composers at the Boston Symphony Orchestra, which plays more than 250 concerts annually. Preconcert talks add to listeners' pleasure. *301 Massachusetts Avenue; www.bso.org*

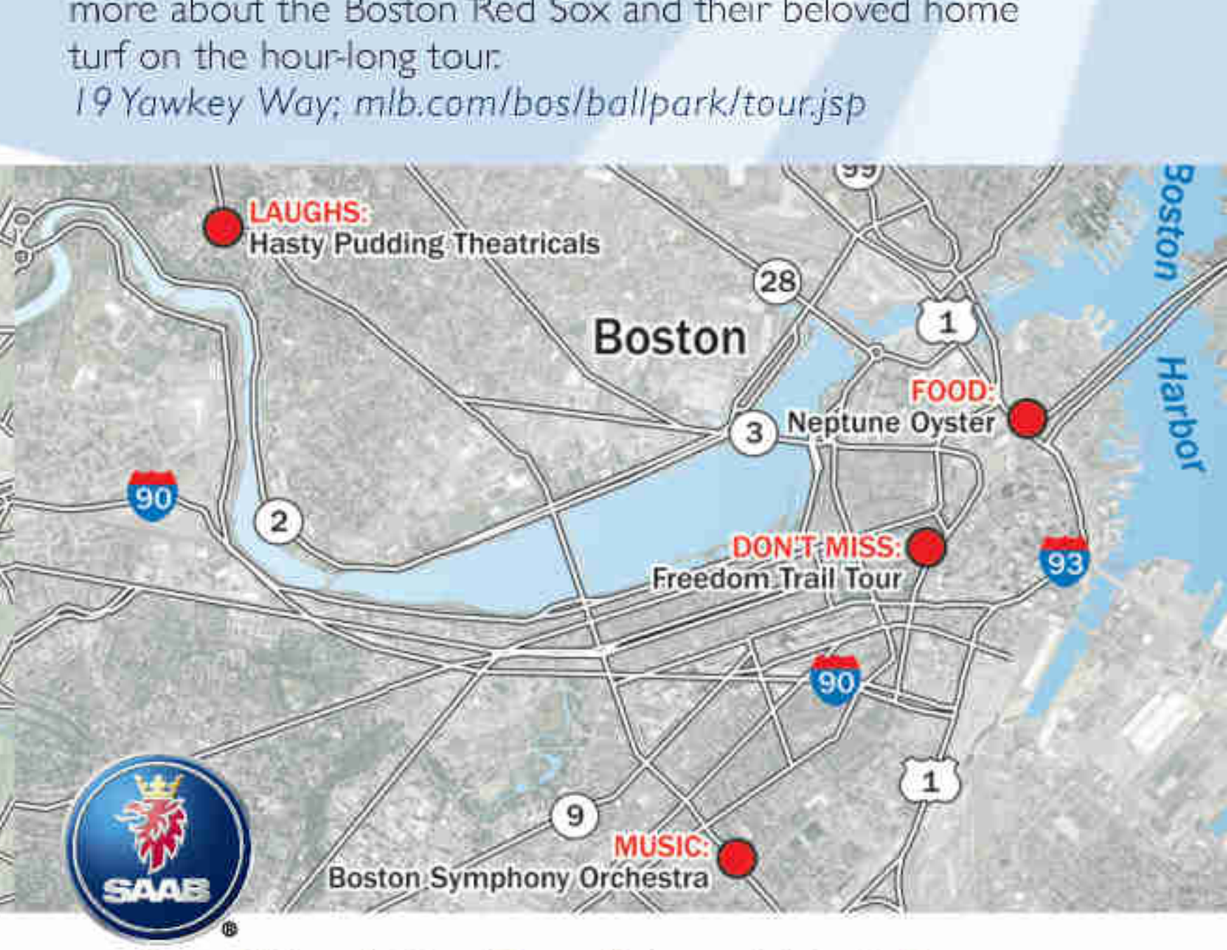
LAUGHS: Brainy yet sophomoric, Harvard University's original, student-written Hasty Pudding Theatricals are performed in February and March at the New College Theatre in Harvard Square. *12 Holyoke Street, Cambridge; www.hastypudding.org*

DON'T MISS: The 2.5-mile, self-guided Freedom Trail tour weaves past 16 historic sites including the circa-1680 Paul Revere House and Faneuil Hall, known as the home of free speech. *147 Tremont Street; www.thefreedomtrail.org*

MUSEUM: Modeled after a 15th-century Venetian palazzo, the quirky, fascinating, and treasured-filled Isabel Stewart Gardner Museum contains some 2,500 works by Asian, American, and European artists on three floors. *280 The Fenway; www.gardnermuseum.org*

SIDE TRIP: Follow the bridge spanning the Charles River to Cambridge, which is home to art galleries and bookstores, cinemas and nightclubs, as well as Harvard (free student-led tours available) and world-class museums including the Peabody (anthropology), Sackler (Asian art), and MIT (innovation). *www.cambridge-usa.org*

LANDMARK: Built in 1912, Fenway Park is the oldest ball-park in the major leagues. Year-round, visitors can find out more about the Boston Red Sox and their beloved home turf on the hour-long tour. *19 Yawkey Way; mlb.com/bos/ballpark/tour.jsp*



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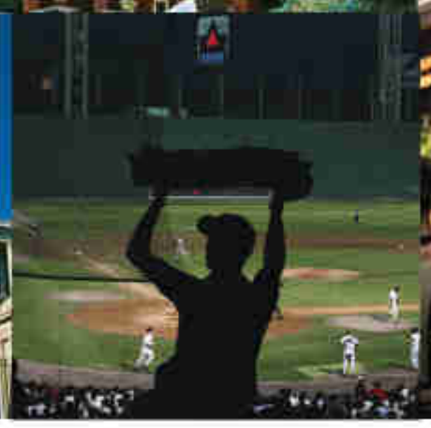



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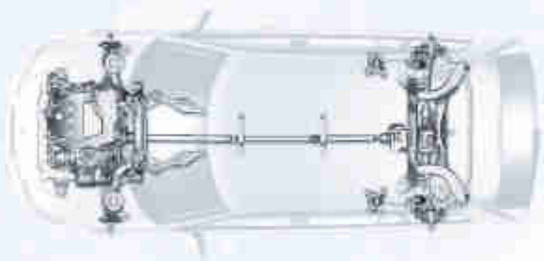

XWD

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From tight parking spots in the nightclub district to San Antonio's River Walk to the dusty Alamo, the Saab 9-3 XWD handles Texas trips with ease. Saab XWD is one of the most advanced all-wheel drive systems ever built. By using advanced electronic controls to intelligently sense wheel speed, steering angle, and lateral acceleration, it actively distributes the torque to match driving conditions. That means power is there when and where you need it most, for amazing stability and great handling in all-weather driving. What you feel is better grip, faster acceleration, increased stability, and agile cornering.

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VISIONS OF EARTH

South Africa Green tree pythons coil when comfortable. Though this snake is a pet in Pretoria, the species is native to northern Australia and New Guinea. In the wild its coloration lends cover for a life spent mostly in trees.

PHOTO: MARTIN HARVEY, CORBIS

Bhutan Novices at the Dechen Phodrang monastic school in Thimphu hear the dinner bell and come running. More than 400 boys attend the academy, where a typical day of study stretches from 5 a.m. to 9:30 p.m.

PHOTO: SCOTT A. WOODWARD

Greenland An iceberg reveals a glimpse of the southern Greenland town of Narsaq. A nearby glacier births a steady supply of bergs that jostle off the settlement's shores year-round.

PHOTO: NICK COBBING

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Product specifications subject to change without prior notice.

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The holidays are Mom's favorite time of year. She loves having everyone together, but some of the grandchildren won't be able to make it this time. It won't be the same without them, so I pre-loaded a digital frame with our favorite holiday pictures and gave it to Mom. It was the perfect gift! Even though everyone can't actually be there, her home is still filled with warm memories.

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HISTORY

Universal Declaration of Human Rights

This silhouette contains the entire text of the declaration.

No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment.

ARTICLE 5

Everyone has the right to rest and leisure...

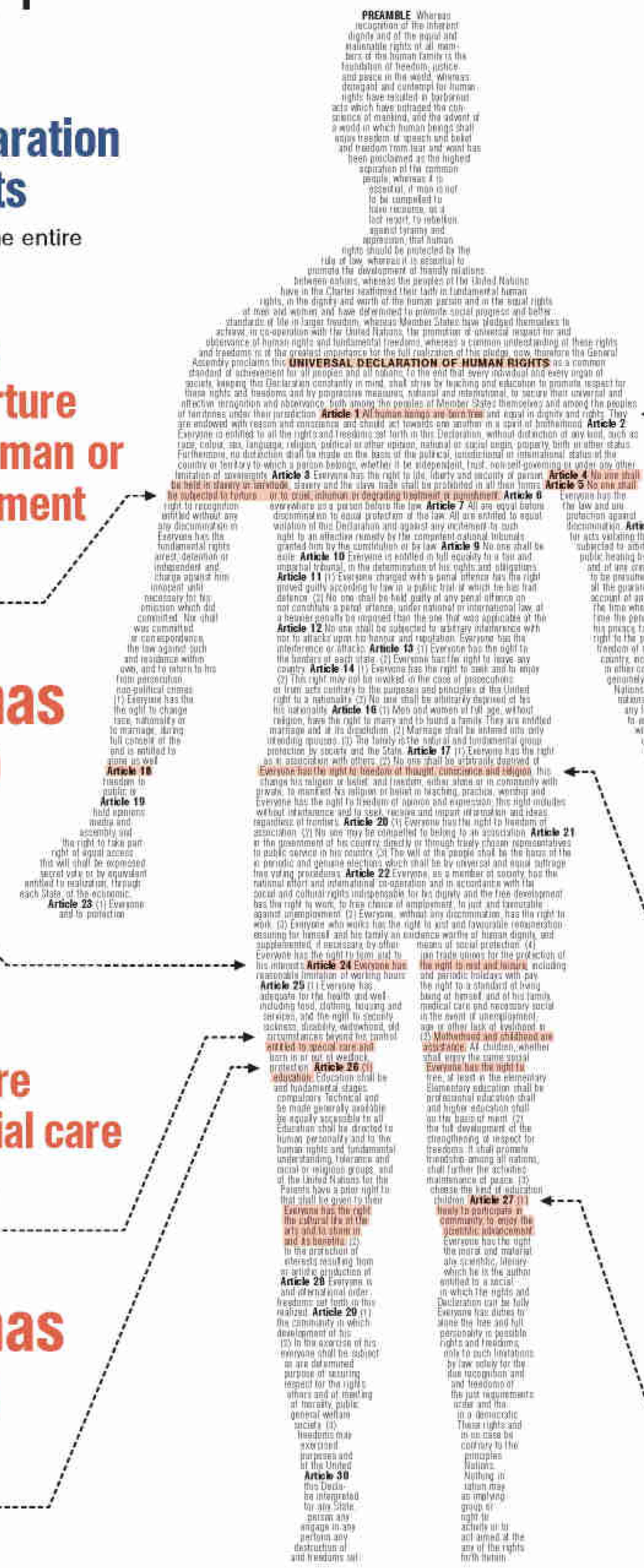
ARTICLE 24

Motherhood and childhood are entitled to special care and assistance.

ARTICLE 25.2

Everyone has the right to education.

ARTICLE 26.1



All human beings are born free...

ARTICLE 1

No one shall be held in slavery or servitude...

ARTICLE 4

Everyone has the right to freedom of thought, conscience and religion...

ARTICLE 18

Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.

ARTICLE 27.1

Words to Honor

Sixty years ago this month, a document of fewer than 1,700 words gave birth to a dream. The Universal Declaration of Human Rights—proclaimed by the United Nations General Assembly in December 1948—envisioned a world that respected the dignity of every human being. In the bloody wake of World War II, the declaration was hope writ large and helped make human rights an accepted barometer of a government's legitimacy. It also led to broad initiatives, such as the creation of a UN High Commissioner for Human Rights in 1993, and focused ones, such as the Rwandan war crimes tribunal in 1994. "The declaration's words are inspiring," says Kenneth Roth, executive director of Human Rights Watch. "The challenge is enforcement." *—Alan Mairson*

GRAPHIC: OLIVER UBERTI, NG STAFF

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Father Knows Best In a seahorse couple, it's the male that gives birth, delivering tiny fish after the female lays eggs in his pouch. Though that's clearly an unusual arrangement, there are plenty of instances where fathers take sole care of their young. Male sea spiders carry eggs on their legs; male giant water bugs, on their backs. Such behavior is more likely to evolve when males know they're rearing their own young or when their care-giving attracts more potential mates. Mammal moms have to be involved—they make milk—and most bird pairs share care at the nest. But not rheas, relatives of ostriches. At the National Zoo, in Washington, D.C., the male recently dug a nest, sat on the eggs, showed the chicks where to eat—and hissed when curious females came too close. *—Helen Fields*

Eggs stick to cups on the tail of a male leafy sea dragon, a seahorse cousin, in Australian waters.

PHOTO: GARY BELL, OCEANWIDE IMAGES

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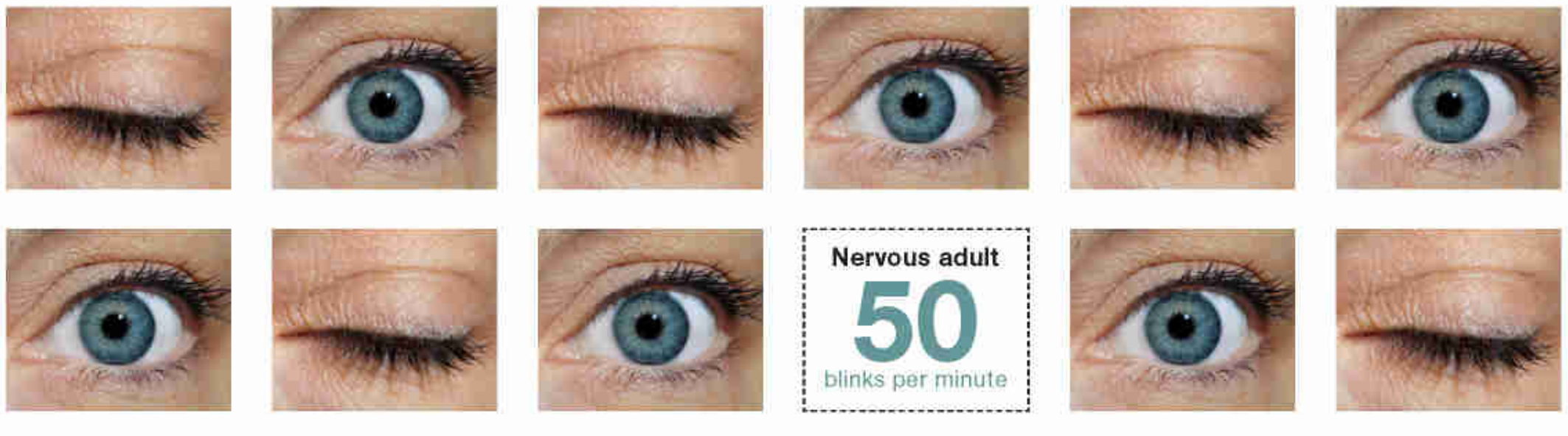

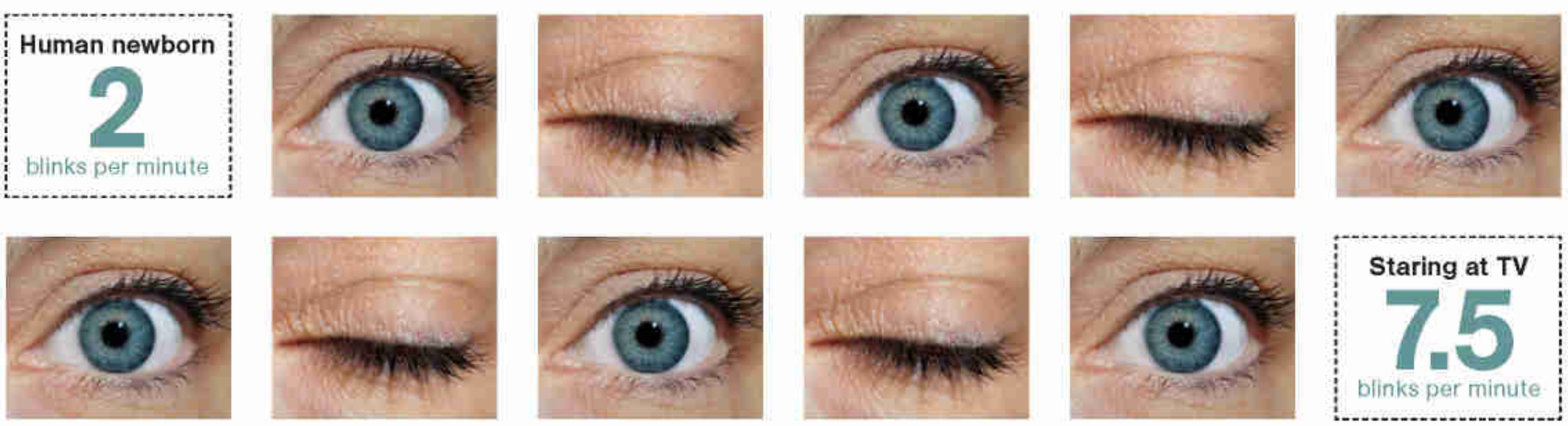

On the Blink What goes on in the blink of an eye? Most obvious, the lid spreads tears across the ball surface, warding off dryness and scratches. We blink less when reading or staring at a computer or TV—that's why eyes dry and burn—more when tired and at times of transition, like turning a page. But blinking isn't just a reflex. Calm slows blinking; anxiety can cause eyeblink storms. Think of a nervous politician or a bad liar, who usually blinks fastest after a fib. Psychopaths, with altered brain function, are less likely to blink vigorously when startled than an average Joe. Also, blinks dull brain activity related to visual awareness, perhaps to keep us from noticing the microseconds of dark. Blink mysteries include why babies do it less than adults—maybe because of all the new stimuli to take in—and why so much variation exists in animals. Case in point: A parrot blinks 26 times a minute, an ostrich, just once. *—Jennifer S. Holland*

Blink rate varies wildly depending on mood, activity, concentration level, age, and species.

PHOTOS: REBECCA HALE, NG STAFF

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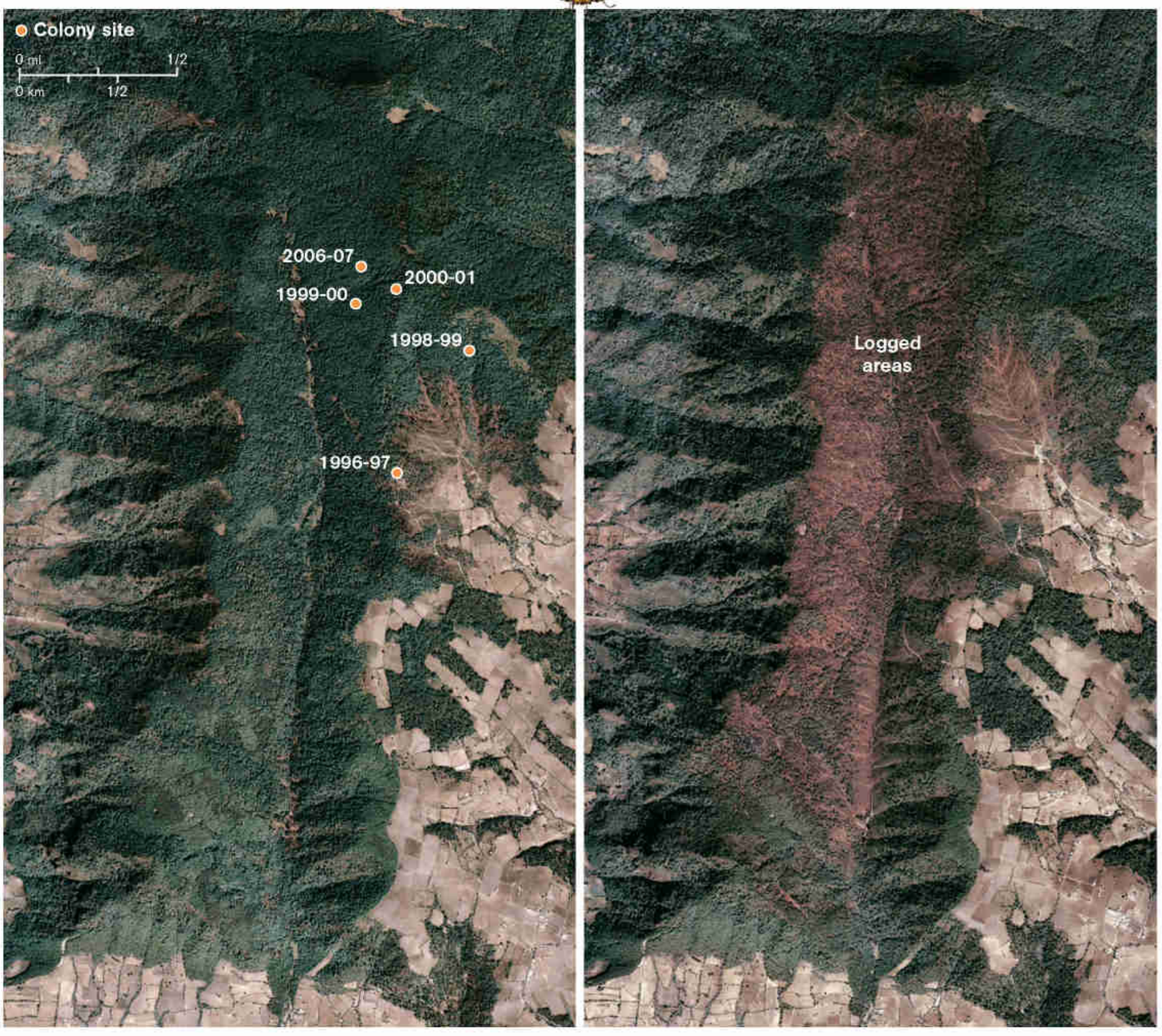
CONSERVATION

Chain Saws vs. Butterflies Each year millions of monarch butterflies migrate from Canada and the U.S. to their winter grounds in mountainous central Mexico. The sight of forests swarming with them—that signature orange and black fluttering on every surface—is world famous. Yet those great gatherings may not last. Recent satellite images show that from 2004 to 2008 illegal logging in the Monarch Butterfly Biosphere Reserve cleared more than a thousand acres, leaving the butterflies dangerously exposed during a crucial period of rest and reproduction. Lincoln Brower, a biologist at Sweet Briar College, warns that the images show only part of a widespread problem—one that's gone unchecked for decades and is worsening. But attention may mean relief: In July UNESCO bestowed World Heritage status on the reserve, a move Brower hopes will prompt a crackdown on logging. "It's got to stop," he says, "or the butterflies will go right down the drain." *—Neil Shea*

Monarchs live on stored fat in winter, but logging (satellite images of effects below) exposes them to more sunlight, raising their temperature and causing them to burn fat faster.



March 22, 2004 **February 23, 2008**

IKONOS SATELLITE IMAGES: ROBERT SIMMON AND DAN SLAYBACK, NASA/SSAI; IMAGES COURTESY MONARCH BUTTERFLY SANCTUARY FOUNDATION. INSET PHOTO: DON FARRALL, GETTY IMAGES. NGM MAPS

Discovered: Three Kings' Silver Coin from the Time of Jesus' Birth

Imagine holding in the palm of your hand an ancient silver coin minted by one of the three kings who sent their emissaries towitness the birth of the baby Jesus. Imagine owning a coin that was touched by the people who walked among Jesus during his years on earth. Today, through an exclusive release by GovMint.com you can own an authentic silver Drachma, saved from destruction and preserved for over 2,000 years — just in time to celebrate Christ's birth!

Miraculous Find Garners Worldwide Attention

Finding an ancient Silver Drachma coin anywhere in the world is a noteworthy event. Finding one issued by one of the "Three Kings" of the Bible, a coin produced by the King of Persia from 35 BC to 5 AD and used throughout the life of Jesus Christ, is cause for true excitement. Intricately designed, it is a miniature work of art. In ancient times the Silver Drachma was struck by hand, one at a time, so no two are exactly alike. This was a coin that could have easily been used to purchase the gifts presented to the Christ Child and has been historically proven to have circulated in Jesus' lifetime.

The Parable of the Lost Drachma

The Silver Drachma was a coin well known to Jesus and his followers. In one of his parables Jesus says, "Or what woman, having ten drachmas, if she loses one, does not light a candle and sweep the house and look diligently till she finds it? And after she has found it, she calls in her friends and says, Rejoice with me, for I have found the drachma that I lost" (Luke 15:8-9).

A Precious Christmas Gift

Your Silver "Kings" Drachma from the time of Christ will arrive housed in a deluxe presentation album together with historical information detailing this coin's amazing journey. A signed Certificate of Authenticity guarantees the coin is from the time of Christ and is sure to be cherished by friends and family.

Note: Quantity strictly limited at this price. Orders filled on a first-come, first-served basis. This offer is subject to change without prior notice. Sold out orders will be promptly refunded. © GovMint.com, 2008

Very Limited at this Low Price —

This special offer of Ancient Silver Drachmas from the time of Christ is made possible by a recent discovery. The quantity is strictly limited and once they are gone, there is no telling when, or if, any more will ever be found. This coin has sold nationally for $135, but while our supply lasts you can own this Ancient Silver "Three Kings" Drachma for just $49.95. Additional savings are available for multiple coin orders (see details).

Specifications

Years of Issue: 35 BC — 5 AD
Composition: Silver
Design: King Azes II on Horseback
Weight: 2 grams (approx.)
Diameter: 15 mm

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Purchase your Ancient Silver "King's" Drachma for a full month risk-free. You must be 100% satisfied or simply return it within 30 days via insured mail for a prompt refund of the purchase price.

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Perfect imperfection, the natural raw 2 carat diamond

Ready for some rough stuff? We recently found a rare cache of extremely large uncut diamonds at an extraordinary price.

Sometimes it's impossible to improve on perfection. When the world's most desired stone is pulled from the ground, why not just brush off the earth and leave it alone? White cut diamonds may be nice for a polite kiss on the cheek, but extra large uncut diamonds can really ignite some raw passion. And isn't that what a great piece of jewelry is all about? These few rare 2 carat plus natural stones will certainly turn up your thermostat.

A real diamond in the rough

For centuries, large raw diamonds were treasured without a hint of facet or polish. We believe the early artisans were on to something. After a search through countries on four continents, we have found a cache of rare, very large, 2 carat plus uncut diamonds at a spectacular price from our Belgium dealer. Major gemstone experts across the globe have commented that rough diamonds will be the fastest growing trend on "the red carpet" this year and our long love affair with flawless cut white gemstones may have some competition. All one has to do is flip through the world's most exclusive catalog to find that "rough is all the rage" Our luxury retail friends in Texas recently featured a raw solitaire for $6,000, but they buy in such small quantities that they cannot compete with us on price. You see, Stauer is one of the largest gemstone buyers in the world and last year bought over 3 million carats of emeralds. No regular jewelry store can come anywhere close to that volume.

Similar rough diamonds sell elsewhere for thousands! *Please compare the size and price of our raw diamond in the Stauer Raw Diamond Necklace with those at your local jewelry store.*

Equal parts "rough" and "refined"

Our ***Raw Diamond Necklace*** is a balanced blend of geology and geometry. Each one-of-a-kind raw diamond is fitted by hand into its "cage," a crisscross embrace of gold vermeil over the finest .925 sterling silver, bead-set with 18 round diamonds. The caged diamond hangs from a triangular bail with an additional 8 diamonds (26 total). The pendant is suspended from an 18" gold vermeil rope chain with spring ring clasp. Each raw diamond is naturally unique. This is an extremely limited edition since it took us 3 years to find this small cache of stones.

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FOSSILS

Sea Rex Pliosaurs were as big as buses, with teeth the size of bananas. They likely lay in wait and lunged at prey. They lived in the Jurassic period but were marine reptiles, not dinosaurs. Now University of Oslo researchers have found the largest known pliosaur fossil: a 50-foot-long, 150-million-year-old specimen in a hillside of shale on the high Arctic island of Spitsbergen, 400 miles from Norway's coast.

The remote site isn't an easy place to work. Everything from people to jars of herring must be flown in by helicopter, and fossil hunters have to keep an eye out for hungry polar bears. Paleontologist Jørn Hurum doesn't mind. He's studying one of the richest deposits of marine reptiles anywhere; his team has found 40 so far, including one other pliosaur. The fossils at the site could help explain the ecosystems of the ancient sea. Tooth marks might illuminate the food chain in an era when the Arctic was warmer—and hospitable even to cold-blooded reptiles. *—Helen Fields*

A pliosaur in the Jurassic sea flaps its mighty paddles to nab another marine reptile, a plesiosaur (top).

ART: RAÚL MARTÍN

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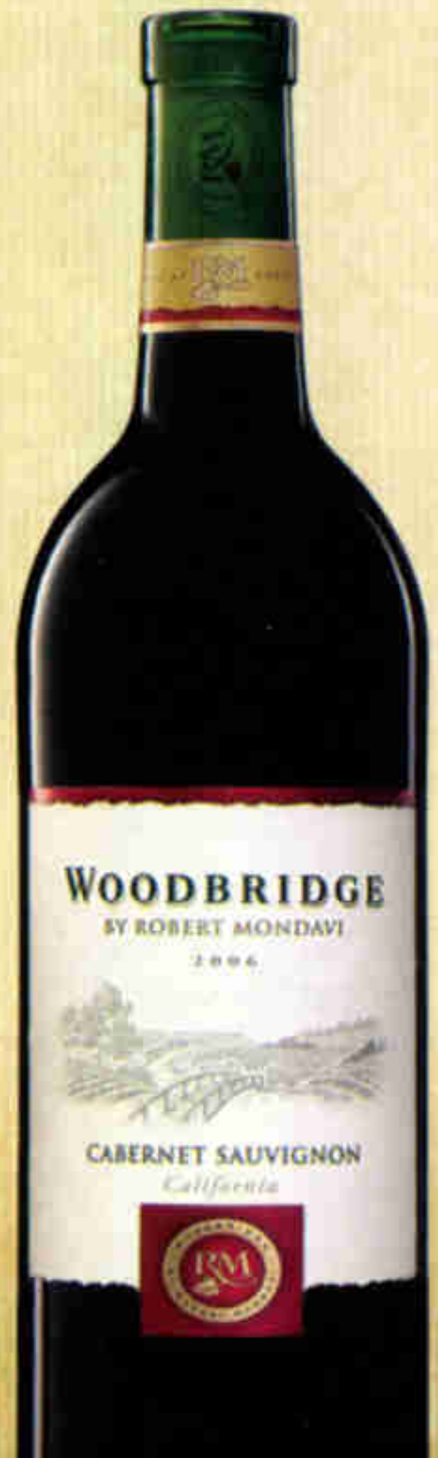
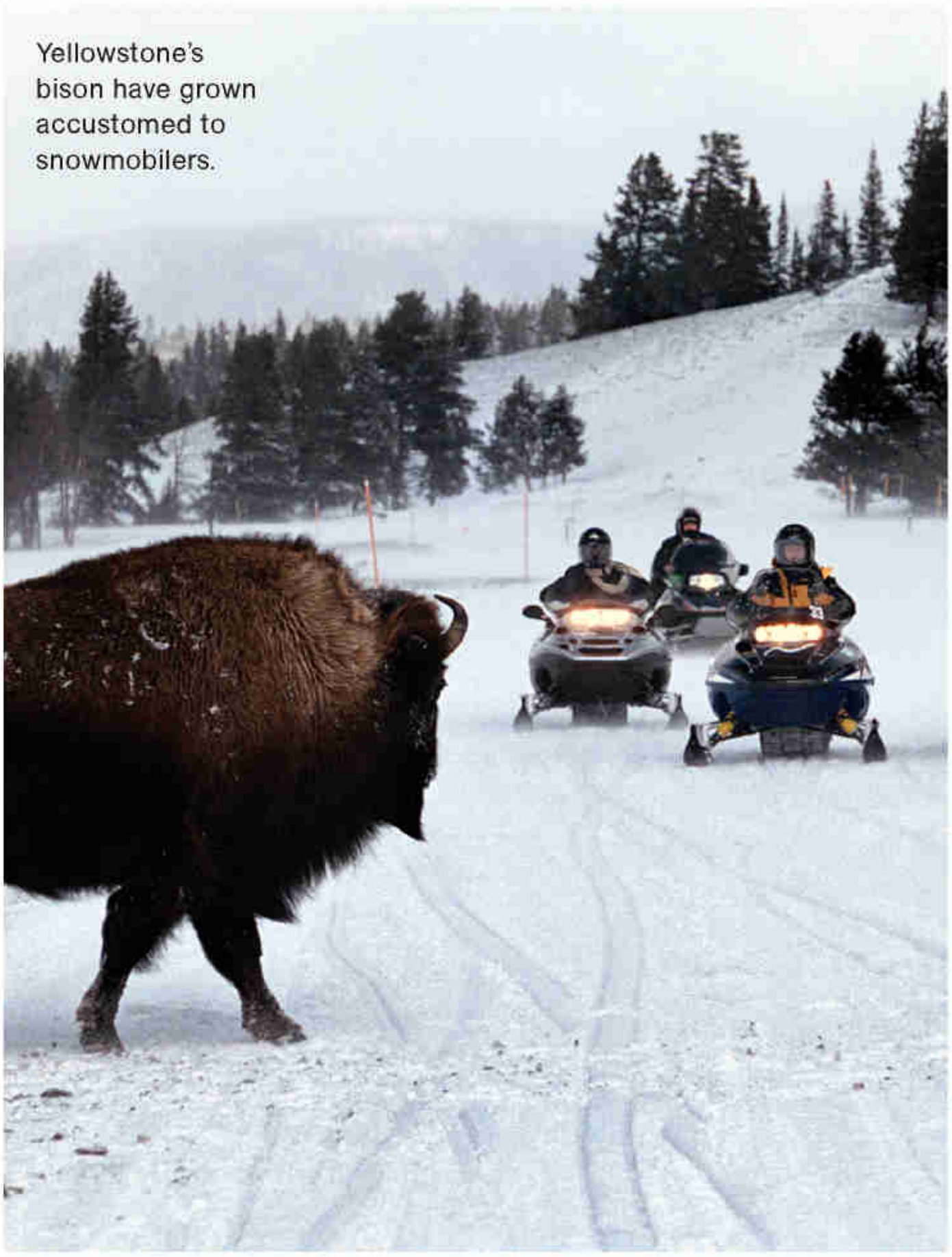
Skeptics laughed when Robert Mondavi doggedly set out to prove that California wines could be quality wines. But today a glass of Woodbridge by Robert Mondavi may make you smile in a totally different way.



His name is on the bottle. His story is in it.

WOODBRIDGE

by Robert Mondavi



Yellowstone's bison have grown accustomed to snowmobilers.

Snow Brawl

Yellowstone may be on the verge of a new winter hush. In September, a judge struck down a 540-a-day snowmobile limit for the park, ruling the figure too high to protect the soundscape. Here's a look back, and ahead.

The peak: In the 1990s, over a thousand snowmobilers would hit the park on a peak day. That's a lot of decibels (below).

The plan: In 2000, a National Park Service study urges a phaseout and endorses snow coaches—buses on tracks that aren't silent but would cut noise and air pollution, since each one holds 8 to 30 folks. The Clinton Administration signs on.

The debate: The snowmobile industry sues to halt the ban. After much wrangling, the Bush Administration sets a 540 limit.

The alternative: Snow coaches gain popularity. No wonder: They're heated and have windows for viewing wildlife.

The future: The park needs to craft a new snowmobile plan, but quiet seems to have won the day. —*Marc Silver*

SOUND CHECK In winter, most park visitors head by snowmobile or snow coach from West Yellowstone to Old Faithful.

290 snowmobiles and 32 snow coaches entered the park on an average day in winter 2007-08.

70-80 decibels are emitted by each snowmobile or snow coach —similar to a vacuum cleaner.

68 percent of a winter day, from 8 a.m. to 4 p.m., noise generated by snow vehicles can be heard at a station half a mile from Old Faithful.

2 miles is about the farthest that snowmobile noise can carry.

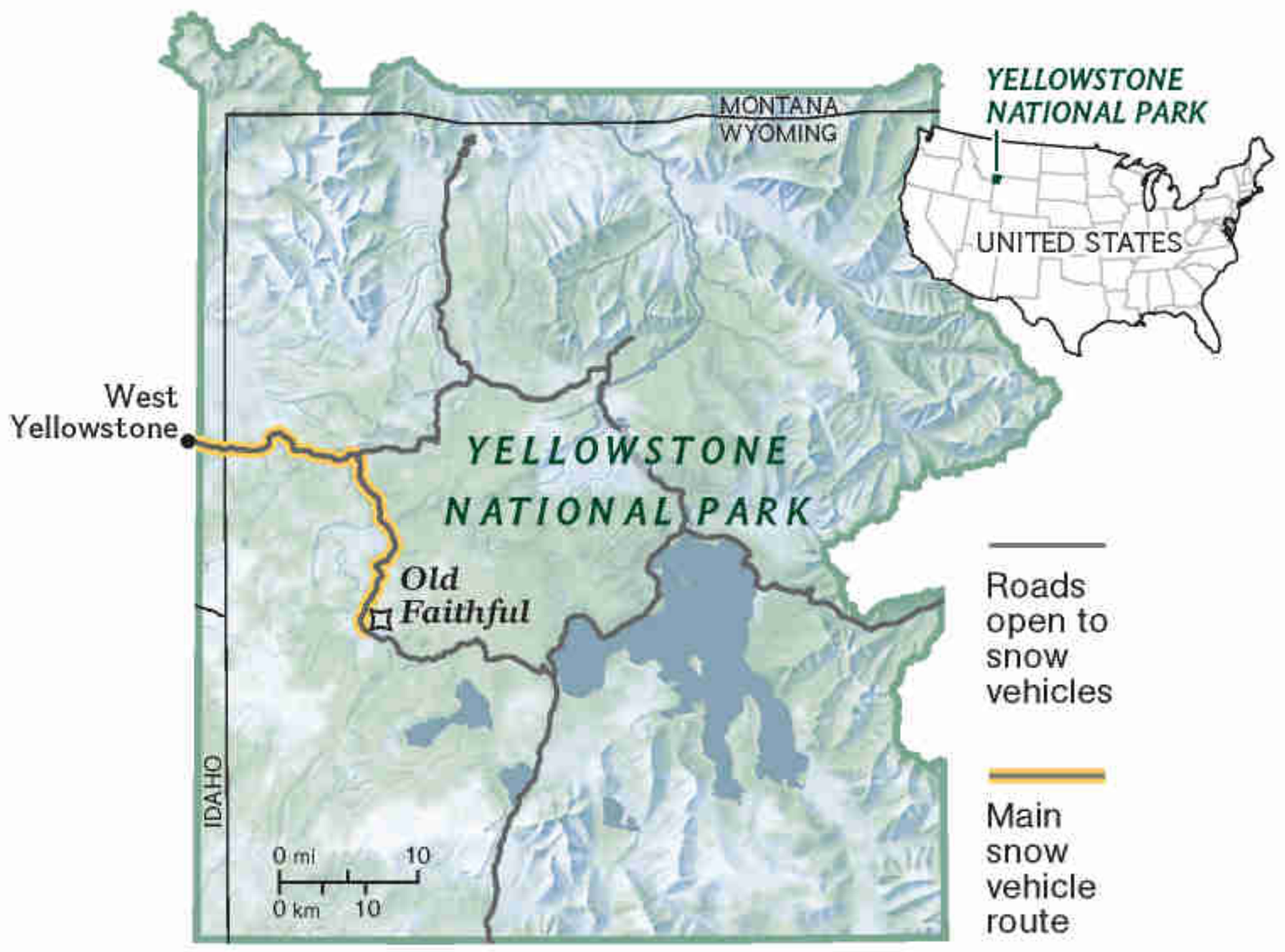


PHOTO: PETE SOUZA, *CHICAGO TRIBUNE*. NGM MAPS. SOURCE: NATIONAL PARK SERVICE

No camera will store
as much as your ***heart.***

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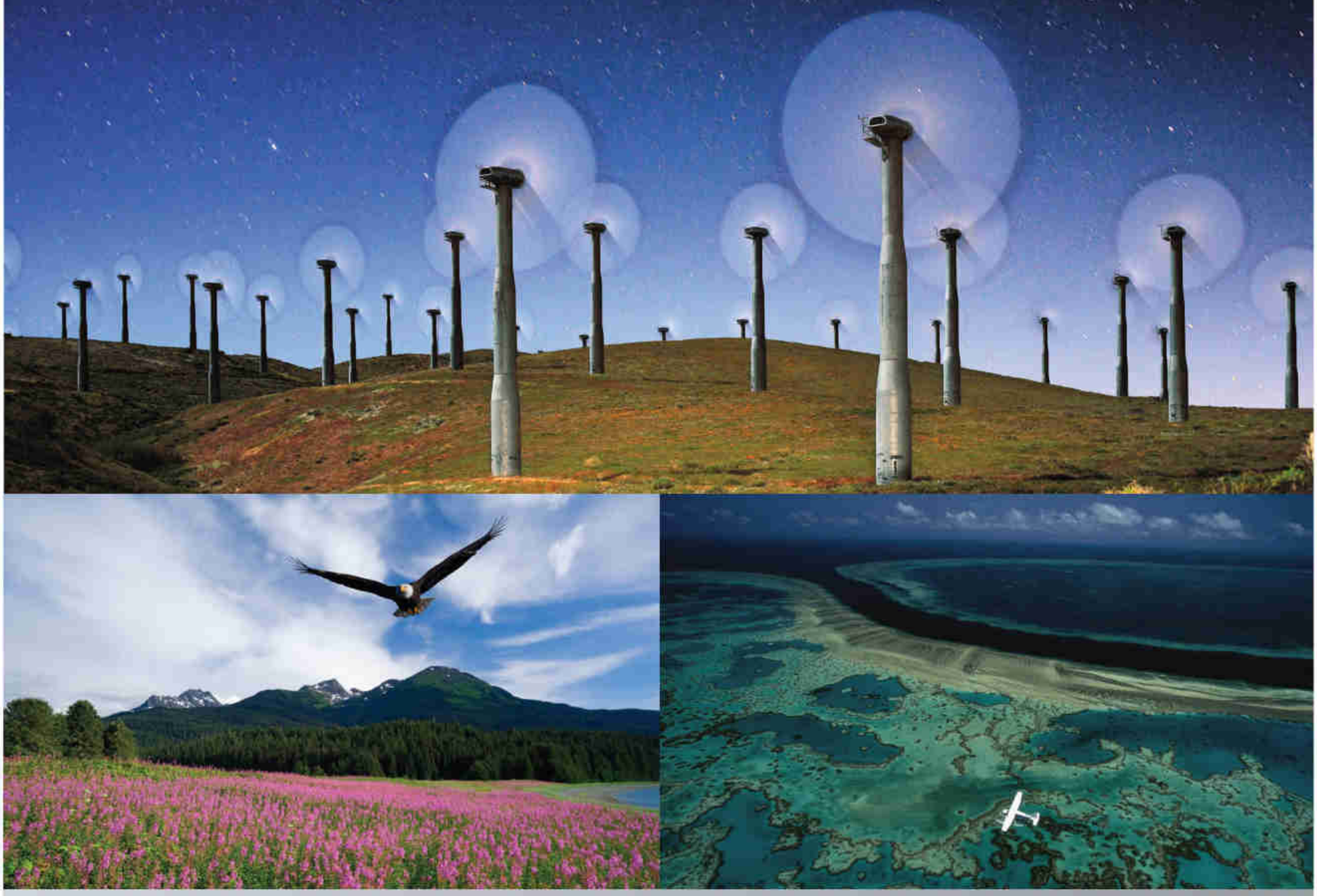
Pathways to a Greener World

How Photography Sparks the Climate Conversation



When it comes to the environment, there are many different roads one can take to celebrate and protect our planet. For photographers, the ability to capture a precious moment in time is an influential way to change the collective consciousness. Through their work around the world, the photographers at National Geographic have pointed their cameras at our Earth's most precious—and endangered—commodities. Their eye-catching photographs have the power to raise awareness of world wonders most of us don't get a chance to see in our everyday lives. A true example of art inspiring action, photography can play a powerful role in reminding us all what really matters.

By offering a visual way to educate the public about global issues, the work of conservationists and scientists can be fully realized. A photograph can stimulate public and private funding, research grants, and worldwide perception. It's true. A picture can change the world.

Visit *nationalgeographic.com/pathways*

Celebrate our planet, and learn about the importance of conservation. Visit *nationalgeographic.com/pathways* for more information.

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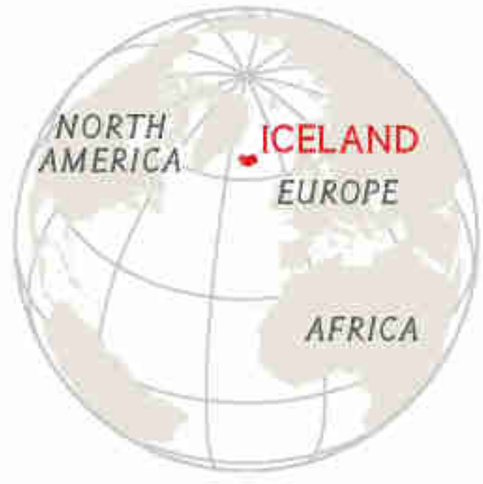
Models shown 2009 GL 320 BlueTEC, 2009 R 320 BlueTEC and 2009 ML 320 BlueTEC. 2009 GL 320 BlueTEC and 2009 R 320 BlueTEC above shown in optional Iridium Silver metallic paint. 2009 ML 320 BlueTEC above shown in optional Alpine Rain metallic paint. Additional optional equipment may be featured. **Road & Track* 10/08. ***Motor Trend* 10/08.

For more information, call 1-800-FOR-MERCEDES, or visit MBUSA.com.

CONSERVATION

Pick of the Nest Each spring, more than 700,000 eiders use Iceland's shores to build their nests, lay their eggs, and take part in a centuries-old exchange: their warm, valuable down for farmers' hay. About 400 Icelanders, most on the west coast, are entitled by property legacy to harvest valuable down from the sea ducks' nests. So each summer they engage in a careful, curious ritual: lifting a hen from her eggs, removing the nest's lining—the bird's inner plumage, which ends up in comforters that retail for as much as $12,000—and replacing it with hay, which the hen accepts. While eider numbers have dipped elsewhere, Iceland's count has remained constant—a sign, perhaps, of the birds' gratitude to the farmers who protect nesting sites. *—Tom O'Neill*



Magnús Guðbjarnason substitutes dry hay for warm down in a temporarily vacated Icelandic eider nest.

PHOTO: RAGNAR TH SIGURDSSON. NGM MAPS

HE HAS $5 A DAY TO CARE FOR HIS FAMILY.

HOW DO YOU GET HIM TO CARE FOR THE ENVIRONMENT?

While these tiny, two-stroke engine vehicles provide a livelihood for many thousands in Asia, they're not doing much for life expectancy. The World Health Organization estimates that atmospheric pollution kills 537,000 people a year in Asia alone. And that's what inspired Tim Bauer and his team to develop a simple conversion kit that reduces exhaust emissions while actually boosting the income of the driver. His combination of ingenuity and economic pragmatism persuaded a panel of distinguished judges to name him one of the five 2008 Rolex Laureates. The winners are each acknowledged for their work to expand human knowledge or improve the lot of mankind. They each receive a gold Rolex chronometer and $100,000 to help them complete their projects. Which should help Tim Bauer and the drivers of Asia breathe a little easier.

THE 2008 ROLEX LAUREATES

TIM BAUER
Developing a cheap and effective upgrade for motorcycle engines to help reduce pollution

TALAL AKASHEH
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ANDREW MCGONIGLE
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ANDREW MUIR
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ELSA ZALDÍVAR
Using local plants and waste products to develop a strong and durable housing material

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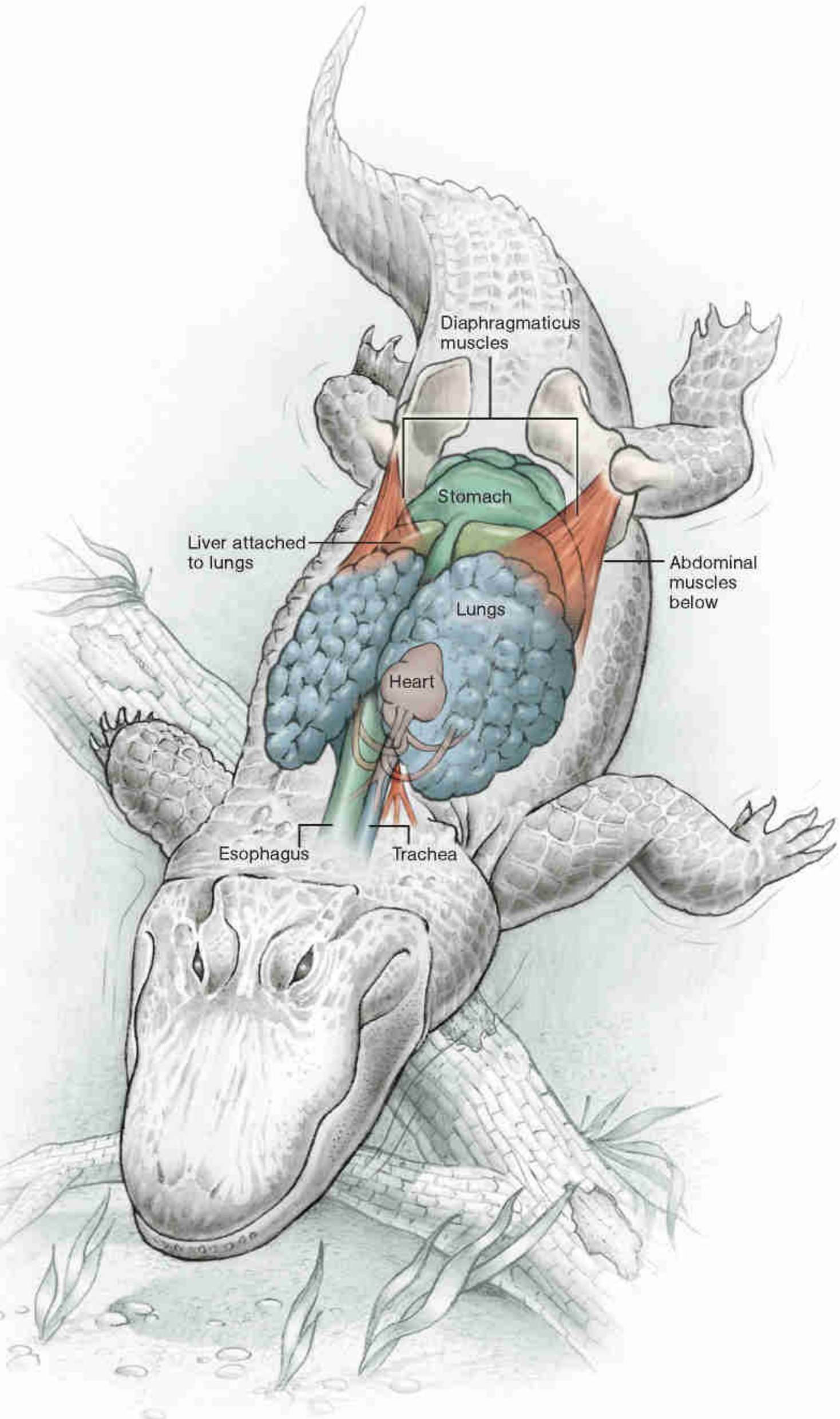
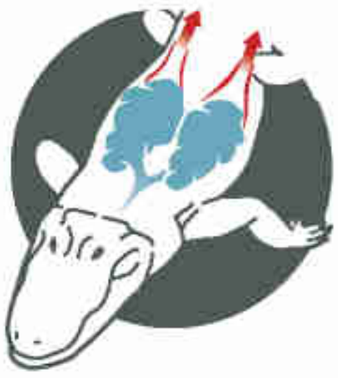
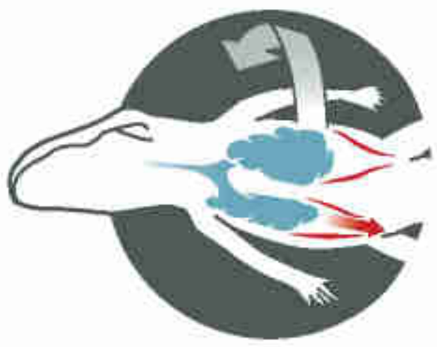


HOW ALLIGATORS MAKE THEIR MOVES

Alligators turn in the water by using their air-filled lungs like floats.



Diving The diaphragmaticus muscles, also used in breathing, pull the liver and lungs back. Buoyancy shifts, tilting the head downward.



Rolling To roll to the right, the breathing muscles of the right side contract. Air shifts to left lung, raising that side.

Surfacing The study's alligators kicked off from a tank floor. In the wild, one might push its lungs forward so its front end floats up.

Aqua Lungs Most reptiles do just fine using only the muscles between their ribs to breathe. But alligators and other crocodilians possess additional muscles that have evolved to help—a whole complex, including the diaphragmaticus muscles, which pull the lungs tailward. That seemed like a lot of extra baggage just for breathing, says biologist T. J. Uriona. He and his adviser at the University of Utah suspected the muscles had another role. Uriona surgically implanted electrodes in five young alligators, then watched each one swim while a computer recorded muscle activity. He concluded that the animals move their lungs and the air inside around to change their angle in the water, aiding smooth and silent maneuvers. He also learned that alligator bites can heal. "Luckily," says Uriona, "the thumbnail grew back." *—Helen Fields*

ART: HIRAM HENRIQUEZ, NG STAFF. SOURCES: T. J. URIONA, UNIVERSITY OF UTAH; KEVIN DE QUEIROZ, SMITHSONIAN INSTITUTION

A few minutes into our drive, a lioness broke from the tall grass and stopped just metres from the landy. "Welcome to the land of the lion," said Vusi our ranger. We couldn't have asked for a better reception.

Go to www.southafrica.net

Let Your Voice Be Heard

Join the Aspen Institute and National Geographic at the second annual Aspen Environment Forum—a powerful event examining the future of the environment and what we can do about it as citizens, corporations, and countries.

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The Aspen Environment Forum—part convocation, part roundtable, and part local town meeting—is open to the public and all are welcome. This is your chance to hear from energy experts, government officials, business leaders, writers, photographers, and other knowledgeable and committed voices in the field.

A wide range of programming includes large plenary sessions, intimate break-out sessions, panel discussions, one-on-one interviews, photography exhibits, screenings, luncheons, book signings, dinner events, evening exchanges, and more.

To register or learn more, go to ***aspenenvironment.org.***

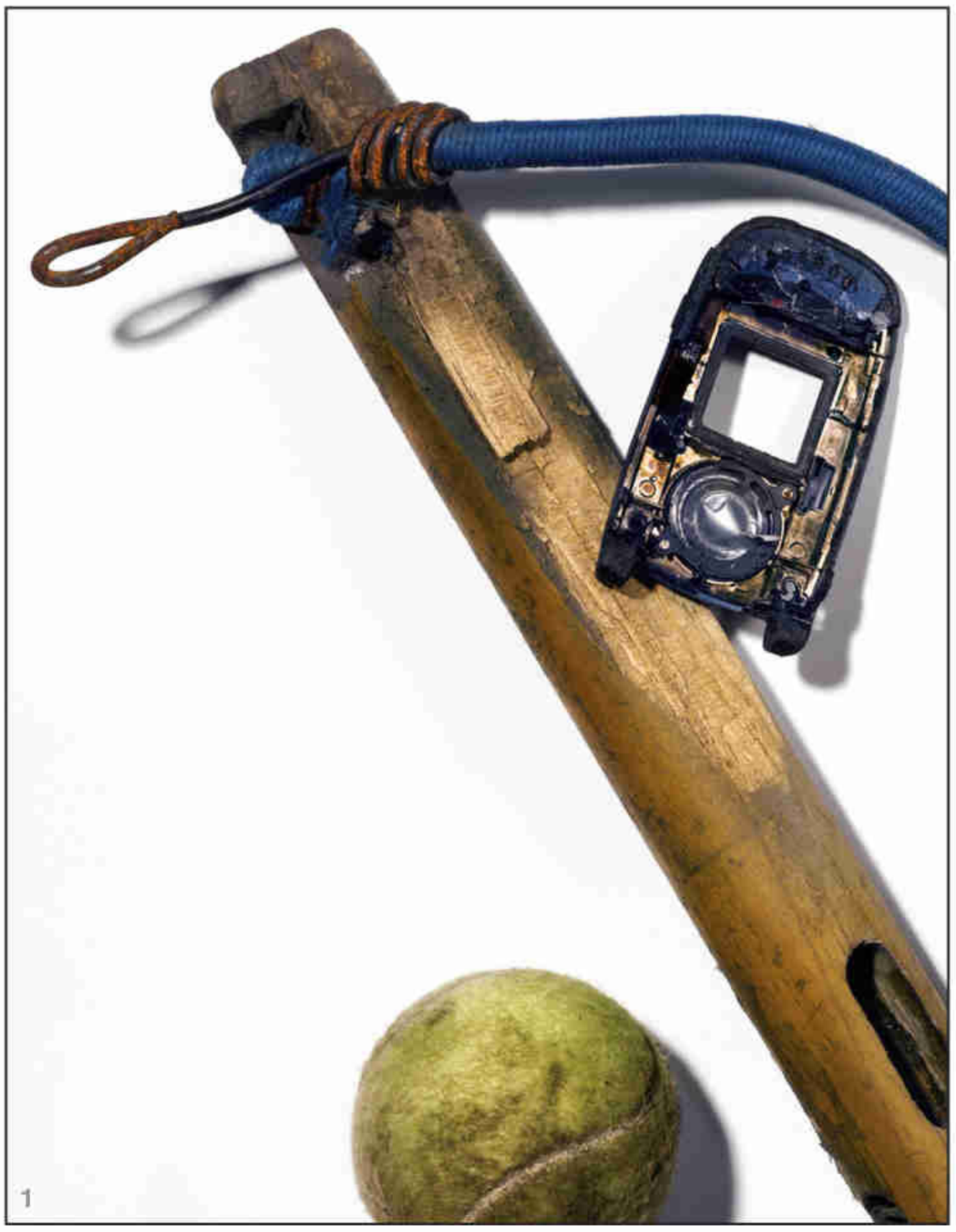
Duke Energy®

Trash Register

The shoulder of I-370 in Maryland is routinely trashed. The litter shown on this page is a small sample of what was found along a 300-foot stretch one July day, which also included a potato chip bag full of half-eaten chicken wings, rain-soaked plastic bags swarming with bugs, dozens of cigarette butts, nails, broken bottles, even chunks of lane striping.

All this litter is a result of heavy commuter traffic and location—near fast-food joints, a construction site, and trash and recycling centers. That's why environmental scientist Steve Stein used I-370 to train staff for a national survey of litter he conducted for the group Keep America Beautiful.

On average, Stein found 704 items for each highway mile, down from 3,289 in the last big U.S. tally, in 1968. He credits the drop to anti-litter campaigns and ongoing cleanup, at a cost of $11 billion a year. The 2008 survey aims to cut the tab by pushing prevention, like teaching truckers to better secure loads and persuading America's top litterers, males 18 to 24, not to toss beer cans out car windows. *—Marc Silver*



1

2

3

TYPES OF TRASH

1 Much litter seems unintentional: a furniture leg, a cord, a remnant of a cell phone, a ball.

2 Tire tread, known as "road alligator," can cause a crash.

3 Cigars and cigarettes leak toxic chemicals into watersheds.

4 Drink cans accumulate unless a state has deposit laws.

5 Unsecured boxes fly off trash trucks.

6 Snack debris piles up on exit ramps: Speeds are slower; drivers think cops aren't watching.

4

5

6

PHOTOS: REBECCA HALE, NG STAFF

Herod the Great's three-tiered palace cascades down the north face of Masada, the work of a king long reviled as a villain but today recognized as a master architect. With Roman techniques and unique ambition, he created audacious masterpieces of stunning beauty.

THE HOLY LAND'S
VISIONARY BUILDER

HEROD

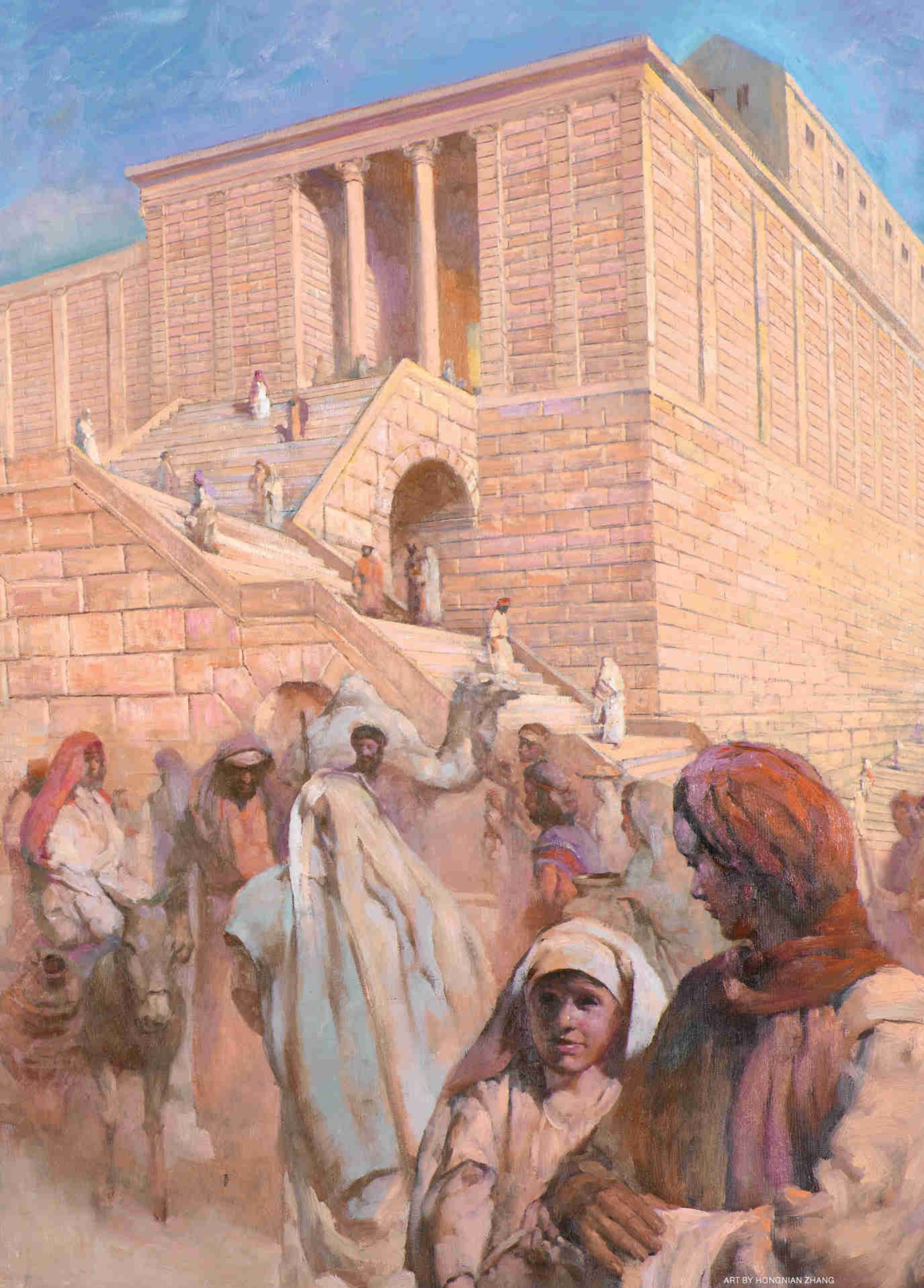
BY TOM MUELLER PHOTOGRAPHS BY MICHAEL MELFORD

SACRED REMNANT

More than two millennia after Herod's death, great stones that supported his magnificent Second Temple complex still stand in Jerusalem. Each day the plaza at the Western Wall fills with Jews, among them dark-clad Orthodox, whose prayers include hopes for a restoration of the Temple.

HOLY OF HOLIES

Towering over bustling streets with imperial grandeur, Herod's Second Temple (highest building at top) and the plaza surrounding it rested on colossal foundations, including the Western Wall (at lower left). These massive retaining structures doubled the size of the Temple Mount.



ART BY HONGNIAN ZHANG

EIGHT MILES SOUTH OF JERUSALEM, where the last stunted olive trees and stony cornfields fade into the naked badlands of the Judaean desert, a hill rises abruptly, a steep cone sliced off at the top like a small volcano. This is Herodium, one of the grand architectural creations of Herod the Great, King of Judaea, who raised a low knoll into a towering memorial of snowy stonework and surrounded it with pleasure palaces, splashing pools, and terraced gardens. An astute and generous ruler, a brilliant general, and one of the most imaginative and energetic builders of the ancient world, Herod guided his kingdom to new prosperity and power. Yet today he is best known as the sly and murderous monarch of Matthew's Gospel, who slaughtered every male infant in Bethlehem in an unsuccessful attempt to kill the newborn Jesus, the prophesied King of the Jews. During the Middle Ages he became an image of the Antichrist: Illuminated manuscripts and Gothic gargoyles show him tearing his beard in mad fury and brandishing his sword at the luckless infants, with Satan whispering in his ear. Herod is almost certainly innocent of this crime, of which there is no report apart from Matthew's account. But children he certainly slew, including three of his own sons, along with his wife, his mother-in-law, and numerous other members of his court. Throughout his life, he blended creativity and cruelty, harmony and chaos, in ways that challenge the modern imagination.

Israeli archaeologist Ehud Netzer has spent the past half century searching for the real Herod, as he is portrayed not in words but in stone. He has excavated many of Herod's major building sites throughout the Holy Land, exploring the palaces where the king lived, the fortresses where he fought, the landscapes where he felt most at home. Of Herod's many imaginative building projects, Herodium was the only one that bore his name, and was perhaps the closest to his heart. It was here, at the end of his daring and bloodstained career, that he was laid to rest in a noble mausoleum.

The precise location of Herod's tomb remained a mystery for nearly two millennia, until April 2007, when Netzer and his colleagues at the Hebrew University in Jerusalem unearthed it on the upper slopes of Herodium. The discovery provided new insights into one of the most enigmatic minds of the ancient world—and fresh evidence of the hatred that Herod excited among his contemporaries. It also became a political incident, with Palestinians arguing that the artifacts at the site belonged to them, and Jewish settlers saying that the tomb's presence strengthened their claim to the West Bank. To Netzer, whose work at various Herodian sites has for decades been interrupted by war, invasion, and uprisings, the controversy was hardly surprising. In the Holy Land, archaeology can be as political as kingship.

HEROD WAS BORN IN 73 B.C. and grew up in Judaea, a kingdom in the heart of ancient Palestine that was torn by civil war and caught between powerful enemies. The Hasmonaean monarchy that had ruled Judaea for 70 years was split by a vicious fight for the throne

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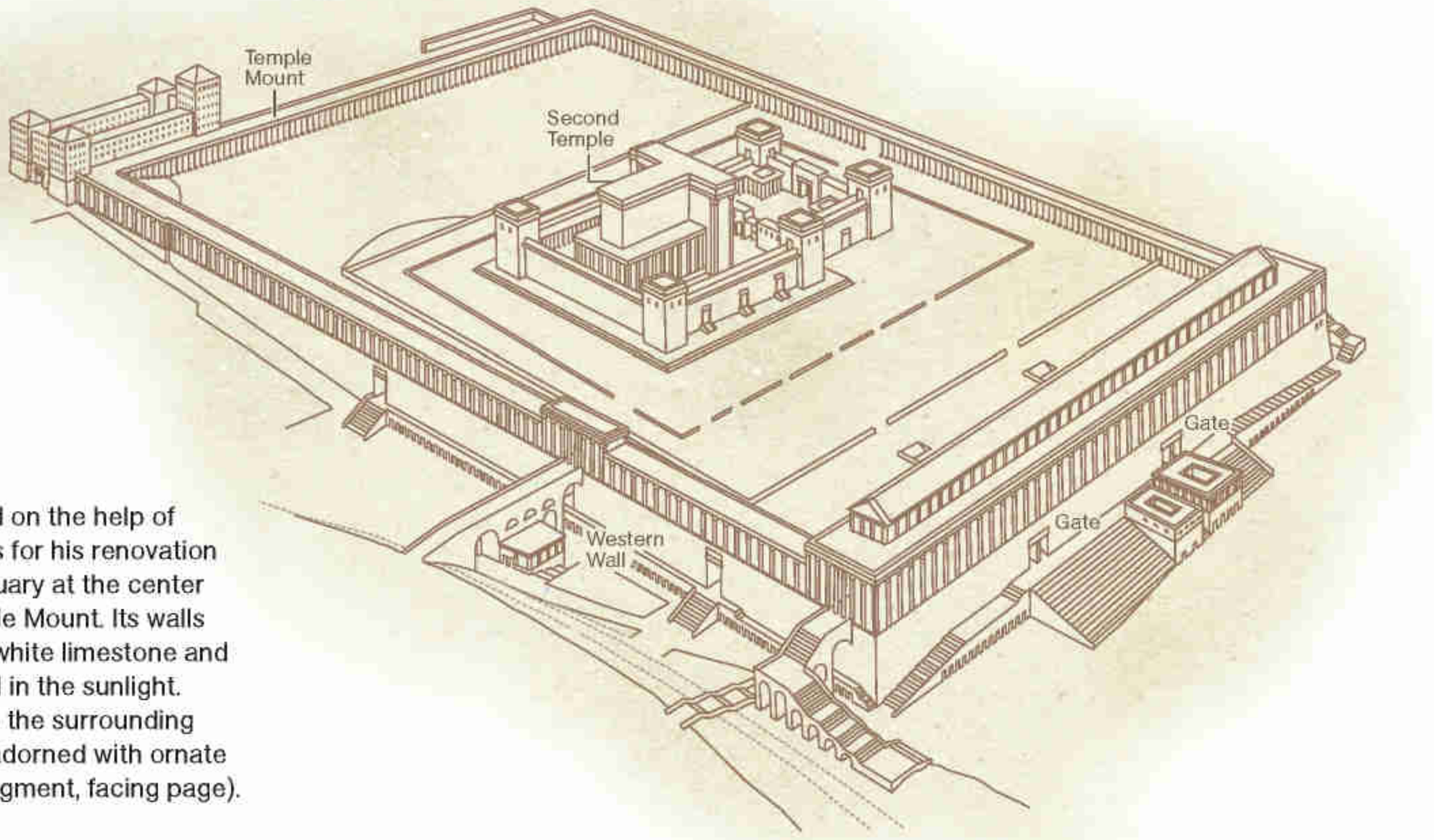
Tom Mueller wrote on biomimetics in the April 2008 issue of National Geographic. *Michael Melford's last feature was on Death Valley, in November 2007.*

between two princely brothers, Hyrcanus II and Aristobulus II. The kingdom was in turn caught in a larger geopolitical struggle between the Roman legions to the north and west, and the Parthians, historic enemies of Rome, to the east. Herod's father, the chief adviser to Hyrcanus and a gifted general, threw in his lot with the Romans, who banished Aristobulus and made Hyrcanus king of Judaea.

From boyhood, Herod saw the benefits of entente with the Roman overlords—a stance that has long been judged a betrayal of the Jewish people—and it was the Romans who would eventually make Herod king. Throughout his career he strove to reconcile their demands with those of his Jewish subjects, who jealously guarded their political and religious independence. Maintaining this delicate balance was all the more difficult because of Herod's background; his mother was an ethnic Arab, and his father was an Edomite, and though Herod was raised as a Jew, he lacked the social status of the powerful old families in Jerusalem who were eligible to serve as high priest, as the Hasmonaean kings had traditionally done. Many of his subjects considered Herod an outsider—a "half Jew," as his early biographer, the Jewish soldier and aristocrat Flavius Josephus later wrote—and continued to fight for a Hasmonaean theocracy. In 43 B.C., Herod's father was poisoned by a Hasmonaean agent. Three years later, when the Parthians suddenly invaded Judaea, a rival Hasmonaean faction allied themselves with the invaders, deposed and mutilated Hyrcanus, and turned on Herod.

In this moment of crisis, Herod looked to the Romans for help. He fled Jerusalem with his family under cover of darkness, and after defeating the Parthians and their Jewish allies in a desperate battle at the site where he would later build Herodium, he traveled on to Rome, where the senate, remembering his unswerving loyalty, named him King of Judaea. He walked out of the senate building arm in arm with the two most powerful men in the Roman world: Mark Antony, the soldier and orator who ruled the Roman east, and Octavian, the young patrician who ruled the west, and who, nine years later, would defeat Antony and assume command of the entire empire, subsequently taking the title

THE SECOND TEMPLE



Herod called on the help of 1,000 priests for his renovation of the sanctuary at the center of the Temple Mount. Its walls of polished white limestone and gold dazzled in the sunlight. The gates to the surrounding plaza were adorned with ornate carvings (fragment, facing page).

ART BY HIRAM HENRIQUEZ, NG STAFF

"Augustus." Then, in an act that symbolized the many accommodations he would have to make to keep his slippery grip on power, Herod led the procession up the Capitoline Hill to the Temple of Jove, Rome's most sacred shrine, and there the King of Judaea offered sacrifice to the gods of pagan Rome.

Now Herod had his kingdom, but he still had to conquer it, which took three years of hard fighting. Finally, in 37 B.C., he captured Jerusalem, and Judaea was his—at least politically. To bolster his social and religious authority, he divorced his first wife, Doris, and married Mariamne, a Hasmonaean princess. But the Hasmonaean threat remained. Two years later, at Passover, Mariamne's teenage brother, the high priest in the Second Temple, received a warm ovation from the crowds of worshippers; Herod, fearing that the young man might one day usurp his throne, had him drowned in a swimming pool in his palace in Jericho.

Herod is best known for slaughtering every male infant in Bethlehem in an attempt to kill Jesus. He is almost certainly innocent of this crime.

The Hasmonaeans were not his only concern. From 42 to 31 B.C., while Mark Antony ruled the Roman east, Herod remained his staunch friend and ally, despite the ambitions of Antony's beautiful Egyptian queen, Cleopatra, who persuaded her love-struck husband to carve out choice portions of Herod's kingdom for her, and even tried to seduce Herod. (He declined her advances.) In 31 B.C., the political landscape was transformed by the Battle of Actium, during which Octavian crushed the combined armies of Antony and Cleopatra and became the first emperor of Rome. Herod, knowing that Octavian would take a dim view of his long-standing friendship with Antony, rushed to the island of Rhodes to meet the emperor and presented himself without his crown, but with all of his kingly dignity. Instead of downplaying his devotion to Antony, he underscored it and promised to serve his new master, Octavian, with the same loyalty in the future. Octavian was so impressed by Herod's frankness and poise that he confirmed him as King of Judaea, and later added other territories to his realm, saying that Herod's *megalopsychia*—his greatness of spirit—was too large to fit a small kingdom like Judaea.

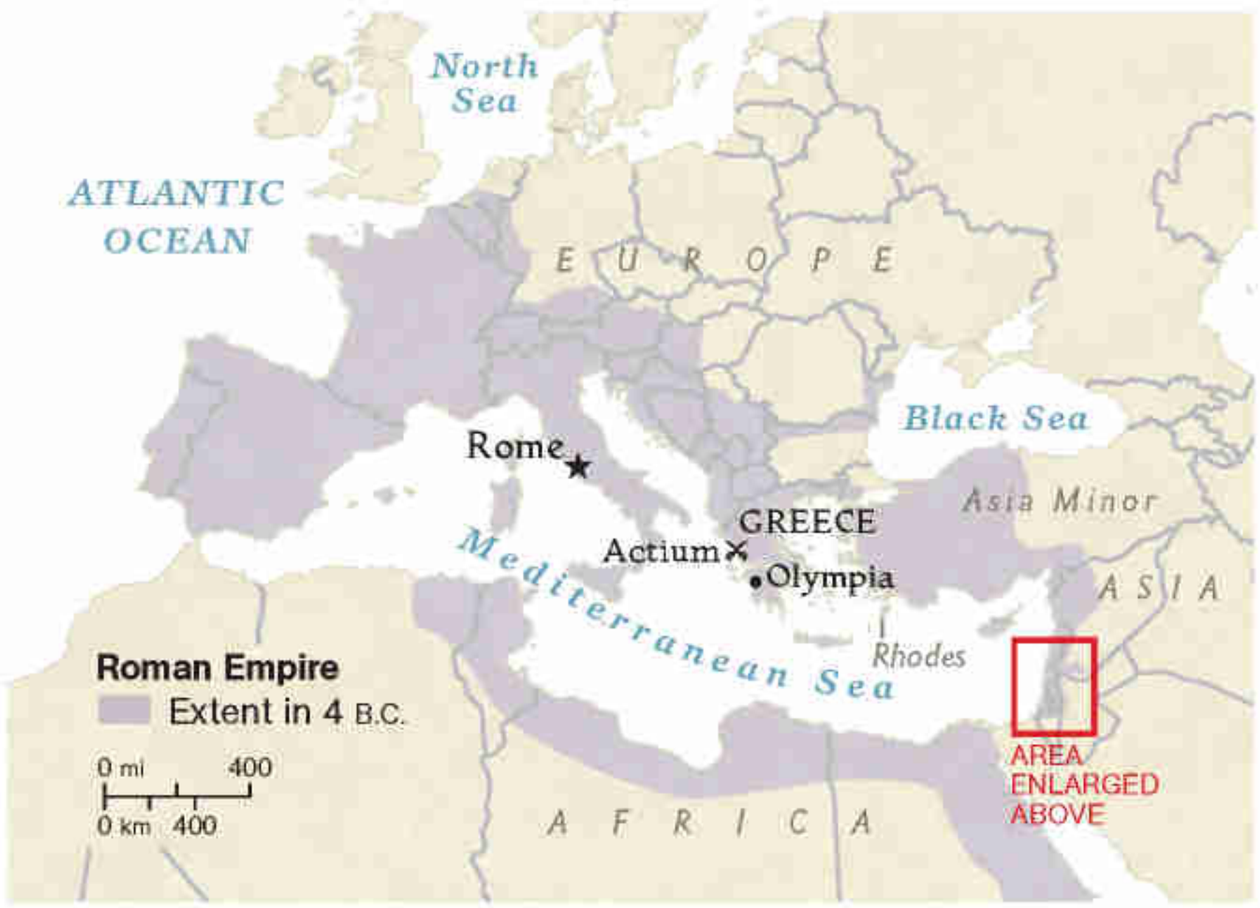
In the two decades of economic prosperity and relative peace that followed, Herod made his court a hotbed of Hellenistic and Roman culture, gathering around him some of the leading scholars, poets, sculptors, painters, and architects of the east and west. He gave with kingly generosity, to his own subjects in times of famine and natural disaster, and far beyond the boundaries of his kingdom, in Greece and Asia Minor. (The citizens of Olympia were so grateful for his lavish donations that they elected him agonothete, or president, of the Olympic Games.) And he undertook building projects of remarkable scope, ambition, and creativity. Since the north coast of Judaea lacked a natural deepwater harbor, he built one from scratch at Caesarea, using an innovative building technique to make an enormous breakwater from massive blocks of hydraulic concrete. Herod's Northern Palace at Masada cascades breathtakingly down a cliff face on three narrow terraces, creating an airy and luminous residence that was also a virtually impregnable fortress. In rebuilding the Second Temple, Herod used gargantuan foundation stones, some over 40 feet long and weighing 600 tons. What remains of this stonework, the Western Wall, is Judaism's most sacred place. Upon it rests Islam's third holiest site, the Dome of the Rock.

The outward grandeur and prosperity of Herod's reign concealed the increasing turbulence

Society Grant This research project was funded in part by your Society membership.

HEROD'S DOMAIN

By Herod's death, the extent of his realm rivaled the biblical kingdoms of David and Solomon. Won by a mix of savvy diplomacy and ruthless conquest, the territory reached from modern Lebanon and Syria in the north, to Israel's Negev desert in the south. A line of fortresses guarded its eastern flank.



The legions of Pompey the Great established Roman domination over Jewish rulers in 63 B.C. A quarter century later, Herod's rise to power relied on the endorsement of Caesar and the senate. In turn, Rome relied on Herod for 35 years to control a restive frontier territory and keep the empire's eastern enemies at bay.

ROYAL STAGE

A theater for 3,500 anchored Caesarea, the port city Herod built to showcase his grandeur. Nearby a deepwater harbor was constructed on a wind-battered point. "Thus the king," wrote first-century historian Flavius Josephus, "conquered nature herself."

of his private life. Like many Hellenistic rulers of his time, he had a large and fractious family—ten wives and more than a dozen children—whose frequent conspiracies brought out Herod's cruelty and paranoia. In 29 B.C., in a blaze of jealousy deftly stoked by his sister Salome, he executed his wife Mariamne, though he still loved her deeply, and lived for months afterward in blackest depression, calling her name as if to summon her back from the dead. In his later years he dispatched three of his sons for alleged conspiracies to overthrow him, and redrew his will six times. During his last illness he devised a scheme to plunge the entire kingdom into mourning when he died, ordering his army to imprison a crowd of leading Judaean citizens in the hippodrome in Jericho, and to massacre them when his death was announced. (Fortunately for these well-heeled Judaeans, his command was not carried out.)

One of the most imaginative and energetic builders of the ancient world, Herod guided his kingdom to new prosperity and power.

Herod's final illness, like the rest of his career, was larger than life—at least according to Josephus, who lists its symptoms with ill-concealed glee: internal pains and burning sensations, swelling of the feet, convulsions, a ravenous appetite, an ulcerated colon, putrefied and worm-eaten genitals, and very, very bad breath. Generations of scholars have exercised their imaginations trying to identify Herod's condition, producing diagnoses that include syphilis, diabetes leading to cirrhosis of the liver, and chronic kidney disease complicated by Fournier's gangrene. Yet in the final analysis, Herod's most serious disorder may have been a hostile biographer. In fact, the symptoms Josephus mentions were part of a stock repertoire of rank and randy ailments, widely considered signs of God's wrath, that had already been used for centuries by Greek and Roman historians to drop the curtain on evil rulers.

Yet Josephus's account of Herod's funeral procession suggests the respect, even the reverence, that his subjects still felt for him. In Jericho, where Herod died in 4 B.C., his body was placed on a golden bier studded with gemstones and draped in royal purple, with a scepter in his right hand and a gold crown on his head. His numerous family ranged themselves around the bier, together with his army dressed in full battle array and 500 servants and freed slaves carrying spices. Together they escorted Herod 25 long, hot miles southwest, to a cone-shaped hill at the edge of the desert that gleamed with white stonework. Here they laid him to rest.

TWO THOUSAND YEARS LATER, I visited Herodium with Ehud Netzer on a cold, blustery February morning. Netzer is a compact man of 74, with steel gray hair, a slight paunch, a prominent jaw, and thin lips set in a straight line in what could be shyness, taciturnity, or even truculence, though now and then his sternness melts away in a broad smile.

We parked near the foot of the hill, at the edge of a village of cinder block houses belonging to Bedouin of the Taamra people, where a six-foot sign declared that Israeli citizens were forbidden by law to enter. "I used to have dinner and take tea here, in people's homes," Netzer said. "Village children would come and play in the excavations. The first intifada in 1987 cooled all that."

Netzer's work at Herodium, like his career and his life, has been cadenced by politics, violence, and war. He grew up in Jerusalem, where his house was shelled by Arab forces when they took the eastern part of the city in 1948, shortly before the founding of Israel. Originally trained as an architect, Netzer started taking part in archaeological investigations in the summers while still a student in the 1950s. He continued to practice the two activities side by side,

keeping his excavations running by using the business skills developed as an independent architect, raising much of the money for the digs himself, employing students when he couldn't afford to hire outside help, and ferrying equipment to and from sites in his station wagon, loading four mud-caked wheelbarrows into the back and strapping five more to the roof.

His first encounter with Herod came in 1963, when he began a three-year stint as team architect of the landmark excavations of Masada, the fortified compound built by Herod on a mesa top overlooking the Dead Sea. In 1967, when the Six Day War and the subsequent Israeli occupation of the West Bank made a number of Herodian sites accessible to Israeli archaeologists, Netzer began excavating two of the richest of them, at Jericho and Herodium, and later several others. "I encountered so many unique architectural designs and solutions that I gradually came to the conclusion that there was one mind behind them all—that Herod had a profound understanding of architecture and urban planning, and took an active role in the erection of many of his buildings."

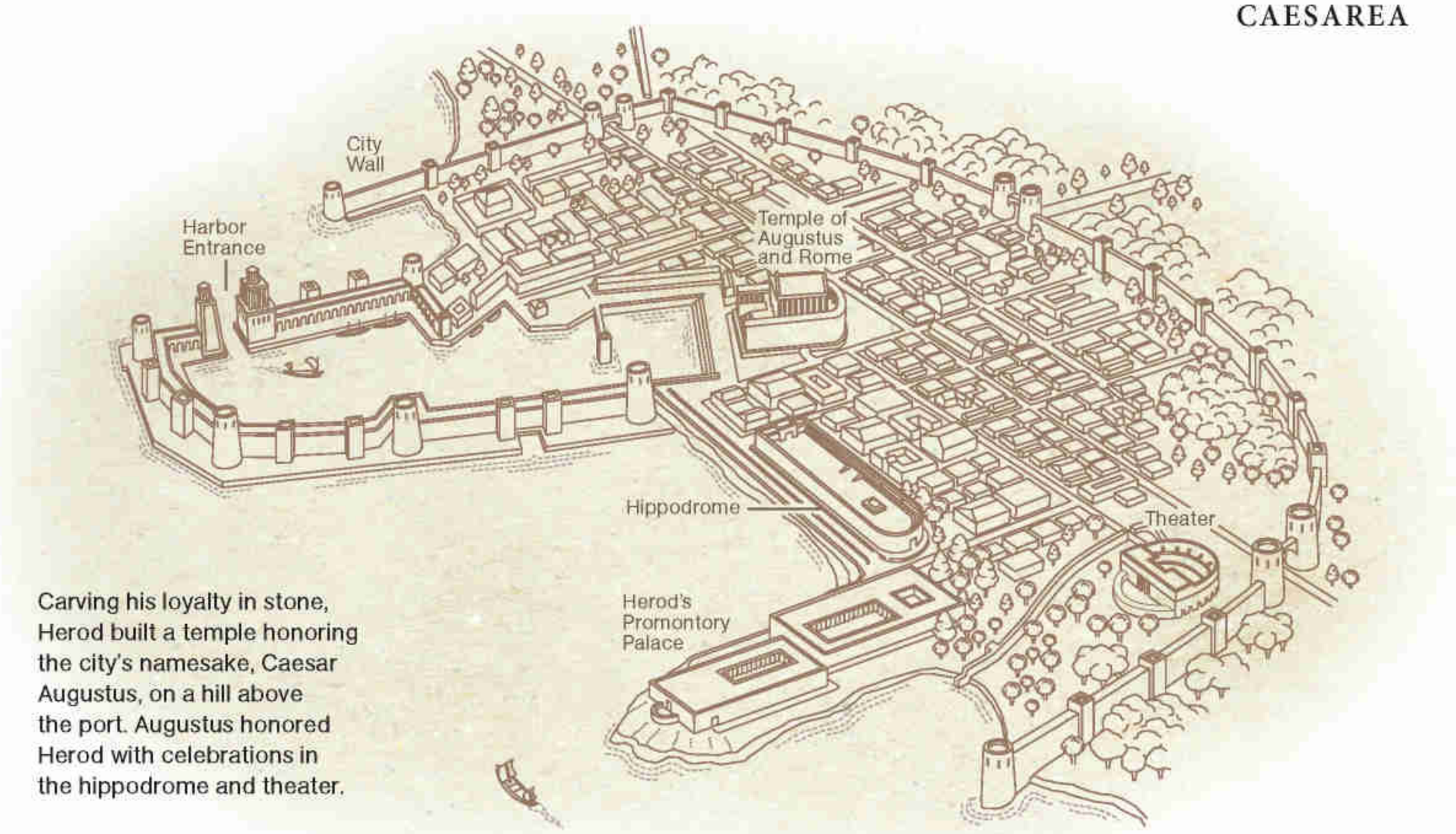
Pulling his hat down low over his eyes against the slicing wind, Netzer led the way off the gravel road into the excavations. For the next several hours we wound our way up the hillside, where goats grazed among clumps of thistle and low green sida plants, and massive ruins recalled the paradise Herod had built on the edge of the desert, like a mirage come true.

Herodium consists of two main sectors: the garden city of Lower Herodium, at the foot of the hill and on its lower slopes—when it was built, it was probably the largest villa complex in the Roman world—and the imposing palace fortress of Upper Herodium on the hilltop, whose massive, five-story East Tower, long in ruins, once dominated the skyline.

"Herodium is a complicated site because it's set on steep terrain, articulated on many levels, and has a wealth of remains," Netzer told me as we started up the slope toward the Lower Palace. "It's a vast puzzle in four dimensions, since time is a dimension too."

Not far from where we had parked, Netzer showed me the Great Pool, where he began excavating in 1972: a rectangular brickwork

CAESAREA



Carving his loyalty in stone, Herod built a temple honoring the city's namesake, Caesar Augustus, on a hill above the port. Augustus honored Herod with celebrations in the hippodrome and theater.

BURIAL OF A KING

"Omitting nothing that could contribute to its magnificence," wrote the historian Josephus, Herod's funeral procession carried his body on a bier of gold, trailed by hundreds of family, soldiers, and servants, to a mausoleum beneath the steep walls of Herodium's palace fortress.

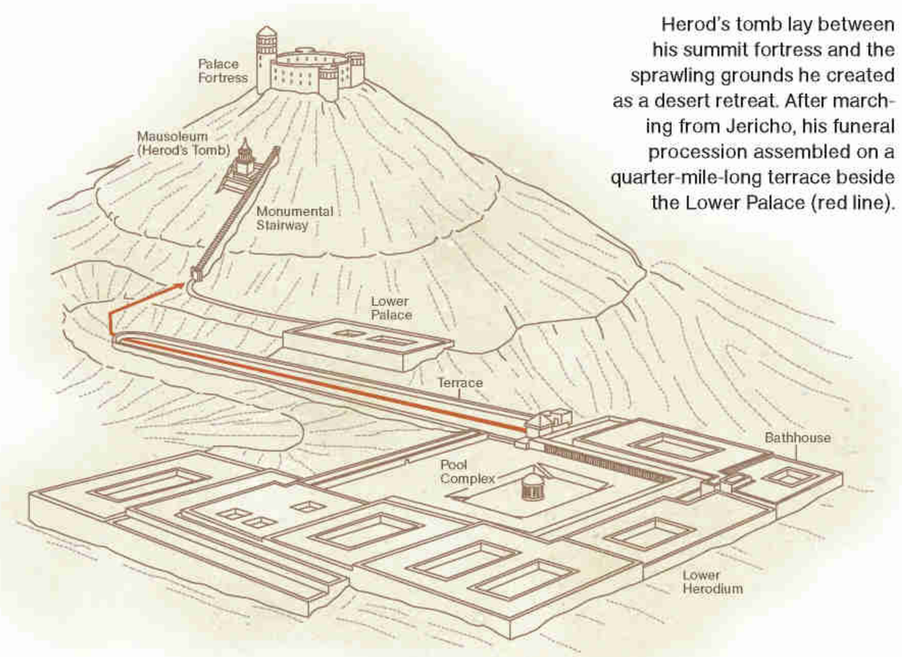
ART BY HONGNIAN ZHANG

MONUMENTAL DISCOVERY

Finding Herod's grave was an epic labor for Israeli archaeologist Ehud Netzer. He had long thought the king was buried in the palace complex at the foot of Herodium's man-made hill, eight miles south of Jerusalem. But in 2007 Netzer's team located a tomb in a dramatic setting halfway up the 300-foot-tall mound (above). Intact stone blocks mark lower courses of the hillside mausoleum (right).

HERODIUM

Herod's tomb lay between his summit fortress and the sprawling grounds he created as a desert retreat. After marching from Jericho, his funeral procession assembled on a quarter-mile-long terrace beside the Lower Palace (red line).



basin surrounded by a graceful white colonnade that once contained a swimming pool almost as big as a soccer field. Over the years, he gradually assembled other pieces of the Herodium puzzle, trying and discarding theories about the identity of individual structures until they fit snugly into the overall meaning of the site. On the lower slopes, we walked out on a flat terrace about 100 feet wide and nearly 1,200 feet long that had been cut into the hillside. "At first we thought it was a hippodrome," he said as we reached the feature. "But eventually we concluded that it was too narrow for the turning radius of racing chariots. So we agreed that it was probably a parade ground, where Herod's army assembled during his funeral."

Netzer's architectural training allowed him to recognize in aerial photographs precise axes

The condition of the sarcophagi confirm that Herod remained vilified even in death. Hammer marks reveal they were intentionally destroyed.

of symmetry that linked buildings in Upper and Lower Herodium. One axis ran due north and south through the center of the hilltop fortress and of the Lower Palace on the hillside below; another, at about 30 degrees to the first, bisected both the Eastern Tower and the Great Pool. This meant that Herodium was built according to a comprehensive master plan, which, Netzer believes, Herod himself probably conceived. "Herodium may well have represented the ideal city in Herod's mind," he told me, "whose orderliness, palatial buildings, colonnades, and splashing water created an atmosphere of peace and tranquillity that he probably yearned for elsewhere." All this beauty from a man who killed his wife and sons, tortured courtiers, and spent long months in stammering madness.

WHEN HE BEGAN TO EXCAVATE Herodium in 1972, Netzer wasn't particularly interested in finding Herod's actual tomb. Yet over the years it became something of an obsession. "We broke our heads on the question of the tomb," Netzer laughed, using a Hebrew expression. In early 2006, shortly after they had returned to Herodium following the second intifada, he tried a new approach. "I said to myself, We've been digging for years in Lower Herodium, and the tomb just isn't there. Let's try the hill." He chose a point high on the slope not far from the East Tower, where his intuition told him that an irregularity in a Herodian wall might signal the presence of an underlying structure.

Netzer and I reached the spot just as a muezzin's voice rang out from the minaret in the village below, calling the faithful to prayer. A shelf had been cut into the hillside, exposing a 30-foot wall of limestone blocks so clean-edged and luminous that it seemed to have risen, fresh laid, from the rough hillside. Yaakov Kalman and Roi Porath, senior members of the excavation team, had just sat down with some other diggers for a lunch of olives, cashews, small white onions, hummus, and dense, caramelly dates. In the spring of 2007, a few months after starting the dig at the new location, his team began to find beautifully carved fragments of a finely sculpted object in hard pink limestone, one of which bore an ornamental rosette common in funerary art. Porath emailed photos of the fragments to Netzer, who was away from the site at the time, with a tantalizing question: "Maybe a sarcophagus?"

On April 27 the blade of Porath's pick rung out, hinting at something massive and hard buried below. He gradually laid bare three massive blocks of white limestone called *meleke,* the Arabic word for "regal." "From the superior quality of the stone, the fine masonry, the amount of decoration, I immediately saw that it was a major find, part of a large and majestic structure," Porath said. He telephoned Netzer,

Fragments of a stone coffin found in the tomb are reassembled at the Hebrew University of Jerusalem. Netzer believes the sarcophagus is Herod's—smashed around A.D. 64 by Jewish rebels who occupied Herodium and loathed the dead king as a puppet of Rome.

who was in the car with his wife, Dvorah. "Ehud was very matter-of-fact during the phone call," she remembered. "He asked Roi about the stonework, agreed that it was different from anything else they'd found in Herodium. He concluded, 'OK, I think that's it.' But after they hung up, he punched both hands in the air and shouted, *'Yesh!'* which means 'It is!' That's a word youngsters use—Ehud never talks like that! I've never seen him quite so happy."

Netzer and his team believe that the monument they gradually unearthed once stood 80 feet high, with a cube-shaped first floor, a cylindrical second floor, and a soaring, high-peaked roof as sharp as a church steeple. Fragments of two other sarcophagi, elegantly carved but of a lesser quality stone, were soon found nearby, as well as a few human bones. By now there was little doubt that Herod's tomb had at last been discovered.

The condition of the sarcophagi fragments confirm that Herod remained vilified even in death: Hammer marks reveal that the sarcophagi were intentionally destroyed. The one made of pink limestone received particularly savage treatment, and was broken into hundreds of pieces. This damage apparently occurred about 70 years after Herod's death, when Jewish fighters occupied Herodium during two brief, ill-fated rebellions, called the First and Second Jewish Revolts, against the besieging Romans. "They viewed Herod as a Roman collaborator, a traitor to the faith and political independence of the Jews," Netzer told me. "They weren't just looting. This was revenge."

For three weeks Netzer and his team kept their discovery a secret. "I wanted to have all the facts clear before making the announcement, because I expected the tomb to receive a lot of attention." He was right. Netzer's press conference

DEAD SEA SHORE

Boulders spiky with salt crystals edge mineral-rich waters where Herod's physician sent him to bathe. Nearly 70 years old, the king was feverish, itchy, and wracked with pain. The therapy failed, and Herod, despondent and increasingly paranoid, tried to kill himself.

on May 8 triggered a political incident. Shaul Goldstein, a leader of the Gush Etzion settlement south of Jerusalem, told the Israeli army radio that the tomb constituted "new proof of a connection between Gush Etzion and the Jewish people and Jerusalem," and called for it to be designated a national and religious site.

Conversely, the Palestinian Authority, clearly worried that the presence of the tomb would strengthen Jewish claims to the area, openly questioned whether the tomb belonged to Herod and protested Netzer's removal of archaeological remains from the site—in the West Bank, and under putative Palestinian control—to Israeli territory. "This is robbery of Palestinian artifacts," Nabil Khatib, the Palestinian Authority's director of the Bethlehem district, told the *Washington Post.*

As if things weren't complicated enough,

Herod's entente with the Romans, long considered betrayal, is beginning to seem more like statecraft.

the site was soon visited by an ultraorthodox group called Atra Kadisha, which defends Jewish graves against archaeologists and roadbuilders alike. They insisted that Netzer's team rebury the bones they had found and seal them in place in concrete. Someone familiar with the Herodium excavations, who asked not to be named, told me that while relations with Atra Kadisha had been cordial throughout, the implicit threat remained that they might forcibly halt work at Herodium, as a continuing offense to a Jewish grave: "They could just board some buses, head out there, and shut the site down." Two thousand years after his death, Herod was still proving a potent political force.

IN LATE AFTERNOON, Netzer and I reached the fortress on the summit of Herodium, its ring of ruined walls forming a crater that accentuated the hill's volcano-like appearance. The sky had cleared, and the world was sharp-edged under a chill desert sun. Just below us, a hunting peregrine falcon arrowed across the sere fields, while in the distance, three F-16s flew low and loud over the smoky blue haze of the Dead Sea. In the Bedouin village where we had parked, children were playing around a water tank, and two white pickups trawled through the streets, loudspeakers blaring in Arabic, their drivers selling bananas and buying scrap metal. On hilltops to the south and west were the Israeli settlements of Tekoa, Kfar Eldar, and Nokdim, their red-tile roofs and garden plots gathered in neat, defensive ovals, in sharp contrast to the welcoming, sandy sprawl and corrugated metal of the Bedouin towns, whose minarets spiked the hills all around. To the east and the south lay desert: the inhospitable Judaean hills and the bare, blood-red mountains of Moab, just across the border into Jordan. Here, in the midst of nature's fierce chaos, Herod chose to build the city that would bear his name, and harbor his tomb.

"I'm sure there were times when Herod put his head in his hands and said, 'What an idiot I was, to say I'd be buried here!'" Netzer said. "But he was a hardheaded organizer, with his feet firmly planted on the ground. He made Herodium a beautiful place, but also an immaculately organized community—a city that worked."

Herod's vision didn't long survive him. After his death, Judaea's prosperity declined. His descendants frittered away the enormous fortune he had left them and squandered the religious and political harmony that he had so carefully fostered. After ten years of ineffectual rule by Herod's son, the impatient Romans assigned a procurator to govern Judaea directly (in the early 30s A.D., the office was held by Pontius Pilate). To many Jews, the Romans now seemed oppressors and infidels. In the First Jewish Revolt, in the late 60s A.D., the rebels held out tenaciously against the Roman legions at both of Herod's hilltop fortresses, Herodium and

With the nightglow of a Jericho suburb on the horizon, elaborate masonry foundations beneath a bathhouse in Herod's winter palace hint at luxuries savored 2,000 years ago. The great builder died here in 4 B.C., celebrated and despised, a despot and a genius.

Masada. At Herodium they vandalized Herod's tomb and reshaped the hilltop: changing his triclinium, a lavish dining room, into a synagogue, and digging two Jewish ritual baths, or mikvahs, into the courtyard. The fighters there eventually surrendered. But at Masada they fought to the end; when defeat seemed inevitable, they reportedly committed suicide rather than become Roman prisoners and slaves. During the Second Jewish Revolt, in the 130s, the two fortresses again became rebel strongholds. At Herodium, they dug a system of tunnels into the hill, which they used to launch surprise attacks on the Romans, and which can still be visited today.

Like Herod's temple in Jerusalem, Herodium and Masada remain prominent landmarks for modern-day Israelis. Their defiant warriors symbolize a religious idealism and high-minded courage in the face of foreign invaders that, to many Israelis, resonates strongly with their country's current position in the Middle East. During the holiday of Tishah b'Ab, when Jews mourn the destruction of the First and Second Temples, some have begun to worship on the Herodium hilltop instead of in Jerusalem. On Masada they hold candlelight vigils and celebrate bar mitzvahs, and officers are inducted into the Israeli army, repeating the fateful phrase, "Masada shall never fall again!"

Yet today, Netzer told me, a growing number of Israelis view the suicidal courage of Masada's defenders as senseless fanaticism. "Many people say that they should have negotiated with the Romans, not fought blindly to the death." Perhaps Herod's entente with the Romans, long considered betrayal, is beginning to seem more like statecraft. The questions raised by his life, concerning independence and collaboration, religious purity and cultural eclecticism, creativity and power, remain vexed and vital to this day. □

THE STOLEN PAST

LOOTING IMPERILS THE HOLY LAND'S SACRED SITES.

BY KAREN E. LANGE
NATIONAL GEOGRAPHIC STAFF

PHOTOGRAPHS BY
MICHAEL MELFORD

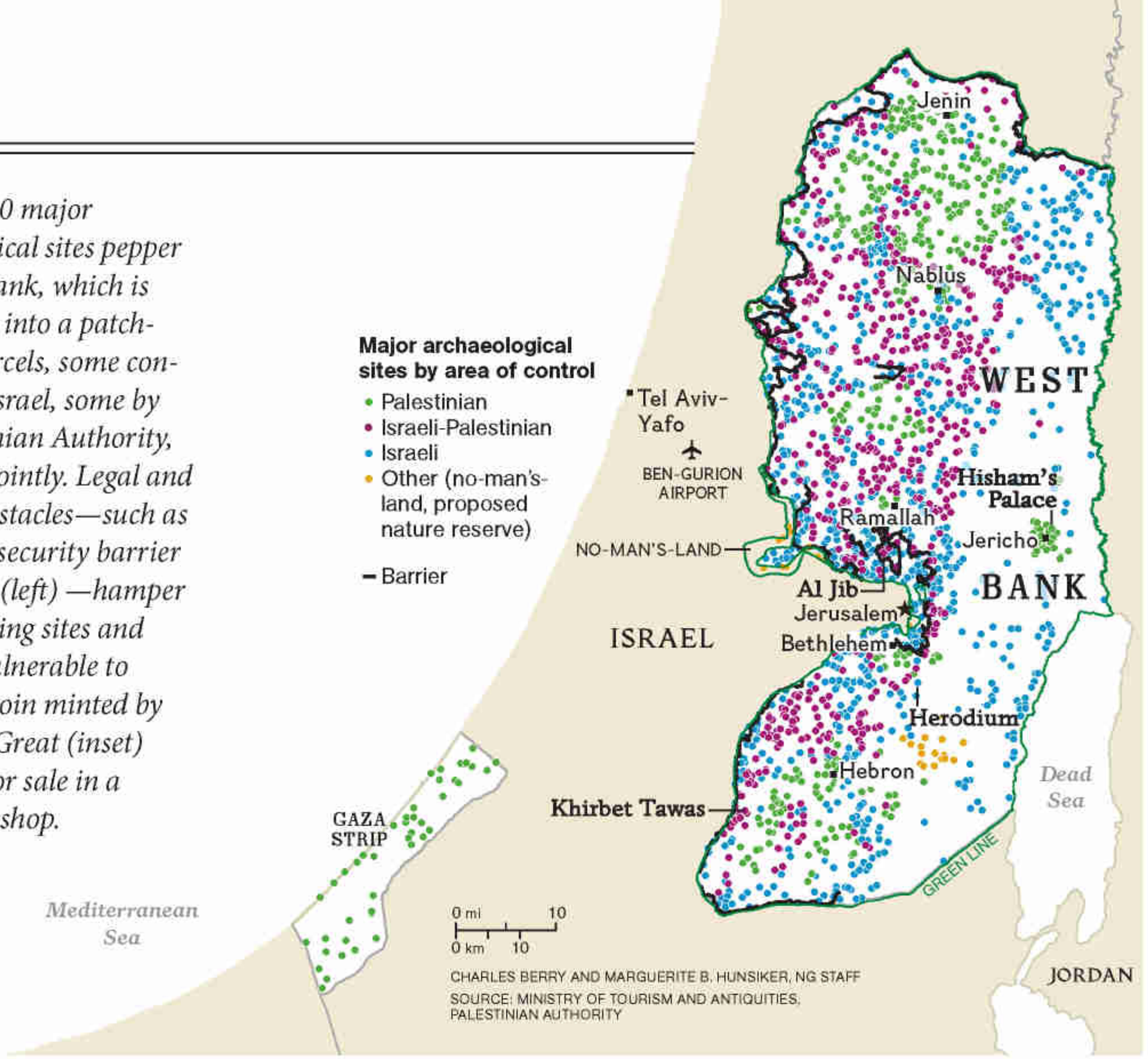
A masked looter in the West Bank shows off the metal detector he uses to mine unprotected archaeological sites for artifacts.

For a thousand years the ruins of Khirbet Tawas, a Byzantine jewel crowning a gentle slope planted in olive trees, stood southwest of Hebron. Graceful rows of columns stretched the length of the basilica, watching over the church's ornate mosaic floor. Then, in 2000, the second intifada struck with the force of an earthquake. As Palestinians fought Israeli troops, the West Bank became all but ungovernable. Soon the Israelis set up a web of security checkpoints, sealed off the region, and barred most Palestinians from working inside Israel. Jobless men looked for cash wherever they could find it. Armed with shovels, a small band descended on Khirbet Tawas.

With ruthless efficiency the looters dug beneath each foundation and into every well and cistern, searching for anything they could sell: Byzantine coins, clay lamps, glass bracelets. In the process they toppled columns and riddled the site with holes, erasing the outlines of walls and doorways—and the only surviving record of thousands of ancient lives. What was once an archaeological treasure and tour stop became a moonscape of craters and rubble. Abu Mohrez, a local imam and shopkeeper, begged the looters to stop, to no avail. He places his hand over his heart and grimaces with regret. "They wrecked the place, and it used to be beautiful."

Since the start of the second intifada, looters have overrun not just Khirbet Tawas but countless other archaeological sites that crowd the West Bank (map, opposite). Few jobs, inadequate law enforcement by both Palestinian and Israeli authorities, and demand for artifacts just across the border in Israel have created the perfect setting for looting, says Morag Kersel, an expert at the University of Toronto on the illegal antiquities trade.

The West Bank is a cradle of civilization, of farming and settled towns. It is also a crossroads of empires. Down its spine of low, stony hills marched the armies of ancient Egypt, Assyria, Babylon, Persia, Greece, and Rome. And for



About 2,000 major archaeological sites pepper the West Bank, which is subdivided into a patchwork of parcels, some controlled by Israel, some by the Palestinian Authority, and some jointly. Legal and physical obstacles—such as this Israeli security barrier near Al Jib (left) —hamper police, leaving sites and artifacts vulnerable to looters. A coin minted by Herod the Great (inset) ended up for sale in a Bethlehem shop.

billions of Jews, Christians, and Muslims, it is sacred ground: the land Abraham sojourned in, Moses pressed toward, Joshua claimed, and David and Solomon ruled in glory; the place where God became flesh; the holy center to which the Prophet Muhammad took his mystical nighttime journey. Yet this priceless legacy is swiftly being lost. "Years from now, I don't know what archaeologists will find when they do excavations here," laments Salah Al-Houdalieh, director of the Archaeology Institute at Al-Quds University in Jerusalem. "They are destroying a cultural heritage that belongs to every Palestinian, to every human being."

While some major sites remain unharmed —Herodium, for instance, is protected by a nearby Israeli military base—in many places the scale of the destruction is almost industrial. Looters attack ancient sites with backhoes and small bulldozers, scraping away the top layer of earth across areas the size of several football fields. Then, guided by metal detectors—coins often give away the location of other goods—they sink shafts to extract anything of value. Among the rock-hewn tombs that honeycomb the hills around Jenin, Nablus, Bethlehem, and Hebron, grave robbers methodically clean out each centuries-old chamber, dumping the bones and hauling off the limestone ossuaries.

In Sair, a town perched on a hillside northeast of Hebron, a middle-aged man speaks with pride of looting as his "work"—the only job he's ever known: "After the occupation [in 1967], when we were boys, there wasn't anything to do or anything to eat. So all of the people went to dig in the archaeological sites. And I saw what they could find." Four decades later, circumstances remain much the same. "Our economy is damaged," says another man who sells illicit antiquities. "We need to feed our families."

Palestinian law forbids looting of archaeological sites, as well as trade in, or possession of, antiquities. But the pillage proceeds unchecked. Sentences are light, typically a few weeks in jail. Critics say the Palestinian Authority could do more to educate its people about the value of

An eighth-century mosaic adorns an Islamic palace in Jericho, but few visitors come to see the masterpiece. Political unrest has crippled the West Bank's tourism industry, and looting threatens its hoped-for rebirth.

their archaeological heritage. Yet both Palestinian and Israeli authorities are hindered by the West Bank's jigsaw of jurisdictional lines.

Under the 1993 Oslo Accords and subsequent agreements, Palestinian officers are supposed to have jurisdiction in cities, towns, and some large villages. They can also enter areas jointly controlled by the Palestinian Authority and Israel, but only after notifying the Israeli military. Entering territory governed solely by Israel (which encompasses some 60 percent of the West Bank) is, practically speaking, forbidden. Palestinian officers who risk going in usually keep a low profile, wearing plain clothes and carrying no weapons. Given such limitations, the outcomes are predictable.

A typical story: One night Namr Boja and five other Palestinian officers went unarmed to arrest villagers near Bethlehem who were digging through tombs. "We shouted, 'We are police! Stop!'" he recalls. "But they surrounded our group and attacked us with rocks."

Israeli soldiers, for their part, can range everywhere. Yet because Palestinians consider any show of Israeli force in the West Bank a provocation, Israel's civil administration is reluctant to send soldiers to drive off looters. "We can't protect sites next to Palestinian villages," says an exasperated Yitzhak Magen, archaeological staff officer for Judaea and Samaria, Israel's term for the West Bank. "We can't go there."

The absence of Israeli patrols and restrictions on Palestinian police effectively leave archaeological sites unprotected, says Hamdan Taha, the Palestinian Authority's antiquities chief. "The system has collapsed."

Some looted artifacts are bought by middlemen who supply shops in Israel, where tourists and pilgrims eager to take home a piece of the Holy Land unwittingly underwrite the trade. Other artifacts are smuggled into Jordan, then on to big-time dealers elsewhere in the Middle East, especially the Persian Gulf states of Dubai and Abu Dhabi. Dealers in those countries, in turn, sell the artifacts to outlets in Israel without revealing their provenance.

Ancient artifacts crowd the shelves of a shop in Jerusalem, where it's legal to sell objects excavated before 1978. But with demand for relics running high, looters find ways to fence freshly dug antiquities.

In Jerusalem along the Via Dolorosa, the sorrowful path tradition says Jesus walked to his execution, looted antiquities are sold beside souvenir vials of blessed soil, water, and oil. Tiny ancient coins such as the mite the New Testament says a poor widow brought as her offering go for $100 and up. Fragile vases of rainbow-tinted glass designed to hold a Roman mourner's tears bring $700 to $1,000.

The Israel Antiquities Authority (IAA) inspects shops and follows up on reports of looted antiquities—defined as any artifacts illegally excavated after the 1978 Antiquities Law took effect. The law requires that artifacts be tracked through assigned inventory numbers, but the rule is easy enough to get around, admits Amir Ganor, head of the IAA's Robbery Prevention Division. Dealers skirt the law either by buying "laundered" artifacts from the Gulf, or doing the laundering themselves by selling registered artifacts to tourists, then reassigning the inventory numbers to looted items that look similar. While tourists are supposed to obtain an export permit before leaving the country, most don't—because dealers often keep silent about the requirement. Some travelers are caught at Tel Aviv's Ben-Gurion Airport, but most pass through undetected.

Alarmed by the spike in looting, Palestinian lawmakers have proposed increasing the maximum prison sentence for damaging archaeological sites from three years to five. Yet political circumstances and deep mutual distrust continue to hamper police on both sides of the border.

In January, Palestinian police slipped into the no-man's-land between an Israeli settlement and a Palestinian village near Bethlehem. There they caught an Israeli and a Palestinian in the middle of what police believe was an antiquities deal. Inside the Israeli's car they found a satchel full of ancient coins, jewelry, and glass. The officers' success was short-lived, however. The Palestinian spent less than two weeks in jail, and the Israeli was turned over to authorities in Israel—who then released him. He hadn't violated any Israeli law. □

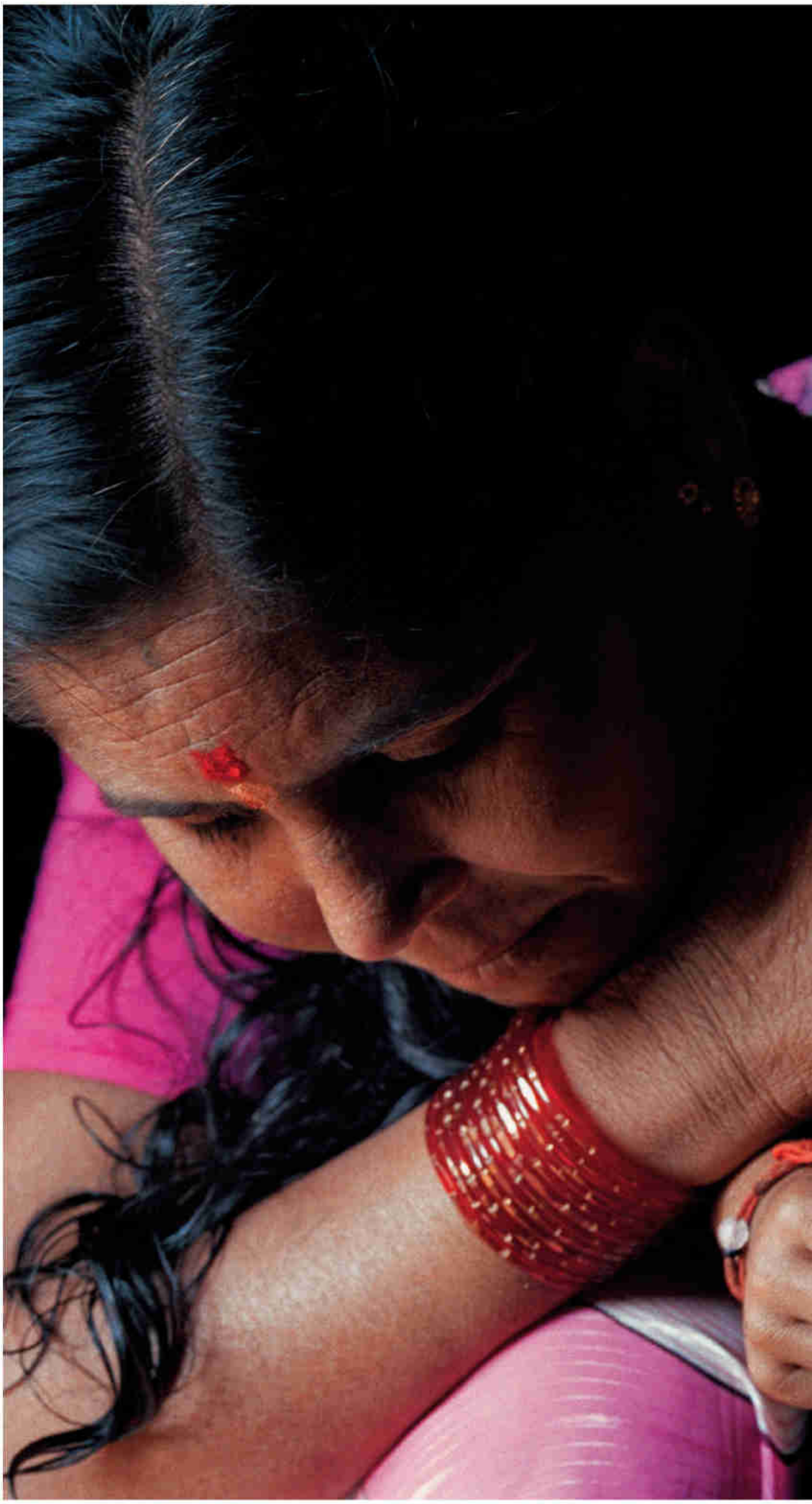
NECESSARY ANGELS

They are not doctors.
They are not nurses.
They are illiterate
women from India's
Untouchable castes.
Yet as trained village
health workers,
they are delivering
babies, curing disease,
and saving lives—
including their own.

BY TINA ROSENBERG

PHOTOGRAPHS BY LYNN JOHNSON

Her fingers gnarled by leprosy suffered as a teenager, Sakubai Gite examines a two-year-old girl she delivered and still cares for.



All calls are house calls for Surekha Sadafule, who checks on a pregnant woman at her doorstep in Matkuli. One of 120 village health workers with India's Comprehensive Rural Health Project (CRHP), Sadafule has earned the trust of poor women, partly because they know that she too has struggled to make her way.

When Sarubai Salve walks through her village, she gathers a crowd.

Salve is 56, a slim, reserved, somewhat stern woman with wire-rimmed aviator glasses and long black hair streaked with gray. On most days she sets off twice, at nine in the morning and six at night, through the streets of Jawalke, a village of about 240 families in the central part of India's Maharashtra state. She carries a blood-pressure cuff, a stethoscope, a baby scale, and a thin logbook. She is often accompanied by Babai Sathe, an exuberant woman of 47, a bit zaftig, with a toothy smile.

The two of them are responsible for keeping Jawalke healthy. They deliver babies and then visit them. They see pregnant women and old people. They take blood pressure and check on villagers cured of leprosy.

Today, a sunny morning in January, the first patient they see is Rani Kale. The house where Kale is staying is made of mud, dirt, and cow dung with a thatched roof. A cat perches on one slope. In the yard, bricks are stacked up, clothes are slung over a line, and small fire pits hold twigs for cooking sorghum flatbread. A brown cow lies contentedly in the shade.

Kale is pregnant. If she were a resident of Jawalke, she would have been seen by Salve many times and sent to the hospital for a sonogram. But she is from a village an hour away. She has come to her mother's house to give birth.

This will be Kale's second baby. She has had no prenatal care until ten days ago, when she first arrived in Jawalke. Salve examined her and advised her to get a sonogram. But Kale never did, and now birth is days, or perhaps hours, away. Salve checks Kale's blood pressure, examines her nails

Founded in 1970, the CRHP (also known as Jamkhed, for the city where it is based) delivers preventive care to poor people who otherwise would get none. The project has served 300 villages and 500,000 people in Maharashtra state, including a newborn baby, fully swaddled and suspended for his weigh-in (opposite) by village health worker Leelabai Amte.

and eyes for signs of anemia, and feels her legs for water retention. She takes Kale inside the hut and lays her on a mat for a pelvic exam. She puts her head on Kale's belly, listening to the heartbeat.

But Kale's belly is so tight that it is hard to detect anything. Sathe looks worried; she believes the baby is out of position. "But sometimes they move," she says. She tells Kale, "We'll come back in an hour or two. If the position is still not normal, we'll take you to the hospital. If you begin labor, just send someone for us." Salve asks one of Kale's aunts to give her tea. "Everything will be fine," she says reassuringly.

Next stop is the home of Manisha Mane, mother of a three-month-old boy with a cleft palate. Sathe and Salve watch the baby suckle, and then put him in a sling and weigh him: nine pounds. Not enough. "You have to supplement," says Salve. They tell Mane how to make a porridge of sorghum, oil, and vegetables. They show her where the baby falls on a growth chart and talk about vaccinations. After tending to Mane's mother-in-law, who suffers from hypertension, Sathe stops at a kindergarten where a government worker is scheduled to give vaccines. When word gets out, the kindergarten quickly becomes a makeshift clinic. Pregnant women and mothers of newborns stop in, and older women come in for blood-pressure checks.

Jawalke is a very different place because of Salve and Sathe. Salve has been doing rounds in Jawalke since 1984. By her own count, she has delivered 551 babies and says she's never lost a single infant or mother. "When I started, the children all had scabies and there was filth everywhere," she says. Small kids used to die. Pregnant women died during and after delivery. Poor sanitation led to malaria and diarrheal diseases. Children went unvaccinated. Leprosy and tuberculosis were common.

I ask Salve about Jawalke's health problems today. "Hypertension and diabetes," she says—rich-country illnesses. In most of rural India, only the fortunate suffer from such diseases.

THE SHORTAGE OF DOCTORS in poor countries is widely lamented, especially in English-speaking countries such as Ghana, Malawi, and India,

where doctors often leave for high-paying jobs abroad. They are pushed to leave by abysmal conditions—major hospitals may have only a handful of doctors and a dozen nurses to care for hundreds. Patients die unnecessarily. Pay is terrible and often months late. But doctors and nurses are also pulled to places like the United States, Canada, Britain, and Australia. These countries don't have doctors willing to work in rural areas or enough nurses at all. They fill the gap with health professionals from poor countries.

The result is that Africa and to a lesser extent India now effectively subsidize medicine in the U.S. and Britain. Ghana, Malawi, and Zimbabwe are among 16 African nations with more doctors practicing outside their countries than in them. In recent years the number of nurses leaving Malawi for jobs has outstripped the number graduating from nursing school. The medical brain drain is a problem being discussed by the G8 forum of the world's richest countries, the WHO, and Harvard University, among others.

But enticing doctors and nurses to stay home may not be the answer to the health care crisis in poor countries. I asked Nils Daulaire, the head of a U.S.-based group called the Global Health Council, what can be done about the fact that there are only, for example, roughly three doctors for every 150,000 people in Malawi.

"Can we get it down to two? Or one?" he said.

Daulaire was only half joking. Doctors, he says, are not the solution for the world's poorest people. Even if they do not emigrate, doctors stay in the cities. In Malawi half of the country's doctors work in just one of four hospitals in major cities, although Malawi is about 85 percent rural. With a handful of exceptions, doctors in poor countries become doctors for the same reason most people all over the world do: to make a good living. If Malawi or India does succeed in recruiting a doctor for a health post in the countryside, chances are that a patient looking for him there will not find him. He will be in the capital, treating patients who can pay.

Even doctors who do treat villagers, moreover, rarely spend time teaching them about nutrition, breast-feeding, hygiene, and using home remedies such as oral rehydration solutions. They don't help villages acquire clean water and sanitation systems or improve their farming practices—ways to eliminate the root causes of disease. They don't work to dispel myths that keep people sick. They don't combat the discrimination against women and low-caste people that is toxic to good health. Doctors also present a powerful institutional lobby that can block the real solution for places like Jawalke: training villagers like Sarubai Salve and Babai Sathe to do all these things.

"Doctors promote medical care because that's where the money is," says Raj Arole. "We promote health." The distinction is crucial to Arole, 75, a doctor himself, and the founder, along with his wife, Mabelle (who died in 1999), of the program, known as Jamkhed, that trained Salve and Sathe. The Aroles graduated top in their class from one of India's most prestigious medical schools, Christian Medical College in Vellore, Tamil Nadu. "They were trying to impose an education that would make you a good doctor in France or Germany," says Arole. But the Aroles had a different goal: to promote health among the poorest of the poor. They worked at a mission hospital, then did their residencies and studied public health in the United States.

In 1970 the Aroles returned to India and established the Comprehensive Rural Health Project in Jamkhed, a small city that is about an eight-hour drive east of Mumbai. They chose the location—not far from where Raj Arole grew up—because it was in one of the poorest parts of the state, frequently drought-stricken almost to the point of famine. There was no local industry or train service. People stayed alive by cultivating small patches of sorghum. Irrigation consisted of asking the gods for rain.

When they came to Jamkhed, the Aroles started a small hospital in an abandoned veterinary clinic. A hospital was necessary to treat

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Pulitzer Prize–winning author Tina Rosenberg is a contributing writer for the New York Times Magazine. *Lynn Johnson is a regular contributor; her photos of Guizhou, China, appeared in the May 2008 issue.*

Infant mortality is actually three things: starvation, diarrhea, and infections. For all three, you do not need doctors.

complicated illnesses and emergencies, and it gave the project political support and credibility. It also brought in fees from patients who could pay. (Those fees, together with donations, contribute the bulk of Jamkhed's $500,000 annual budget for their village work even today.) But the Aroles knew that curative medicine could do very little for the poor. They needed to emphasize preventive medicine, and bring it to the villages. So they decided to engage the villagers themselves. A village health worker, Arole says, can take care of 80 percent of the village's health problems, because most are related to nutrition and to the environment. Infant mortality is actually three things: chronic starvation, diarrhea, and respiratory infections. For all three, you do not need doctors. "Rural problems are simple," Arole says. "Safe drinking water, education, and poverty alleviation do more to promote health than diagnostic tests and drugs."

WHEN SALVE AND SATHE started their work in Jawalke, they were destitute. As members of the Dalit, or Untouchable, castes, they were considered nonpersons, so reviled that higher caste people would throw out food if it even touched the edge of their saris. They went barefoot in the village, as Untouchable women were not allowed to wear shoes. Sathe remembers standing for hours at the local water pump—which she could not touch—waiting for a higher caste woman to take pity on her and fill her bucket. Salve was so poor she washed her hair with mud and owned a single sari. When she laundered it, she had to stay in the river until it dried.

As the Aroles expanded their program to a hundred or more villages outside Jamkhed, they encouraged villages to select women from lower castes. "An educated woman likely comes from a high caste—she may not [want to] work for the poorest of the poor," says Arole. The Aroles believed that empathy, knowledge of how poor people live, and willingness to work were more important than skills and prestige.

Many village health workers were completely illiterate when they began training. When Sathe first started making rounds in Jawalke, she had never attended a day of school. Salve had completed fourth grade. Sathe was married at the age of ten; Salve at two and a half. Every worker I met was married by age 13. Many had been abandoned by their husbands. Others talked about terrible beatings; Surekha Sadafule, who is 26, recounted how her husband threw her down a well after she bore him a daughter. Her parents would not allow her to come home. "You must suffer whatever he gives you," they said. "That is Indian culture."

The health workers' first task was to transform themselves, beginning with two weeks of training on Jamkhed's campus. The Aroles' daughter Shobha, 47, a doctor who is now associate director of the program, conducted some of the training. "I would ask, 'What's your name?' and they would say the village they come from and their caste. They had no self-identity," she says.

"They wouldn't look into your eyes or talk to you. They didn't even feel a woman has intelligence." Shobha's mother would ask the women, "Who is more intelligent—a woman or a rat?" "A rat," they would say. Shobha had the women practice saying their names in front of a mirror. She asked them, "Who is the one person who will never leave you?" Then they would walk behind a curtain to be confronted by the mirror. The training boosted their self-confidence. "Everyone can give technical knowledge," says Shobha. "What makes it successful is time spent building up their confidence." Training is an ongoing campaign: Every Tuesday many of the women return for two days to discuss problems in their villages, review what they learned the previous week, and tackle a new subject, such as heart disease. The women sleep on the floor

Operating on a financial shoestring, a surgical team at the Jamkhed project's only hospital can't rely upon state-of-the-art equipment. But this facility still handles everything from hip replacements to ruptured bowels. Having a hospital as part of the program helps bolster village health workers' credibility.

Sakubai Gite

BREAKING A TABOO

Bathing each morning in her front yard, Sakubai Gite, 32, knows about fresh starts. When she contracted leprosy, her husband banished her from their home. Instead of sinking into isolation, Gite was embraced by women at Jamkhed. "They would sit with me, eat with me, drink tea from my cup," she says. She became a health worker in Pangulghavan, teaching neighbors about nutrition and sanitation. "When we are in trouble," says one woman, "Sakubai guides us." During the past 20 years, leprosy rates in communities served by Jamkhed have decreased dramatically.

under one enormous blanket they sewed together from small ones.

The health workers did not become village authorities instantly. It took months or years for a village to start listening, a process helped along by medical successes, such as delivering a high-caste woman's baby or curing a child's fever. The women also have backing from a mobile team—a nurse, paramedic, social worker, and sometimes a doctor—who visit each village every week in the beginning, then less and less often. The mobile team sees the hardest cases and reinforces the authority of the village health worker. Sadafule told me that she and the mobile team went to the house of a high-caste woman in her village. As the caste system requires, the woman made tea for the visitors, but not for Sadafule—an Untouchable. "The social worker put the cup in my hand," Sadafule said. She had prescribed medicine, but the high-caste woman didn't trust her, and asked the nurse the same question. The nurse confirmed the prescription and asked Sadafule to take the medicine back out of her bag and give it to the woman.

VILLAGES WITH JAMKHED-TRAINED health workers were gradually transformed by their presence. After three or so years, these villages started to look very different from their neighbors. Compared with the misery of the 1970s and 1980s in rural India, there has been some progress even in villages that Jamkhed does not reach: More women are postponing marriage until 18, the use of contraception has reduced family size, and more girls are attending school. But much has not changed. In the village of Kharda, nine miles from Jawalke, wastewater runs in open rivulets. Piles of cow dung swarm with flies. Children have frequent diarrhea, vomiting, and fevers. Some educated young people say they no longer believe old superstitions, but many told me they would rush a snakebite victim to the temple, not the hospital.

By contrast, Jamkhed's successes are dramatic. Thirty-eight years after its founding, the program has trained health workers in 300 villages. Among those that have been in the

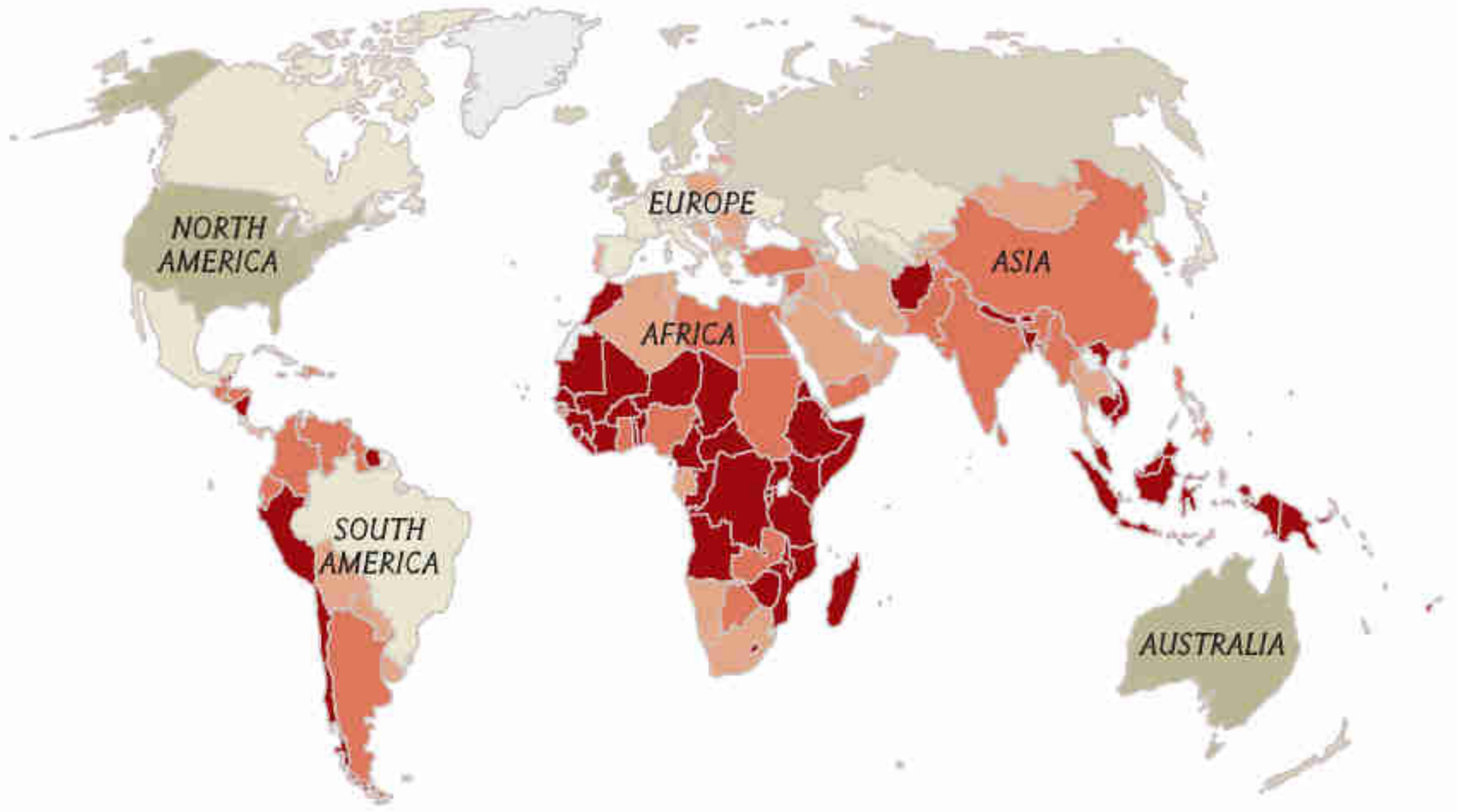
PRESCRIPTION FOR GLOBAL HEALTH CARE

Giving the world's poor equal access to basic health care would take an additional 4.3 million doctors, nurses, and other health workers, estimates the World Health Organization. But merely educating more doctors is not the answer, say physicians in the growing field of global health, who champion health care as a human right and essential to economic development. They see success in public health systems anchored by programs like Jamkhed, which train community health workers to be the front line in preventive care and treating diseases.

NUMBER OF HEALTH CARE WORKERS

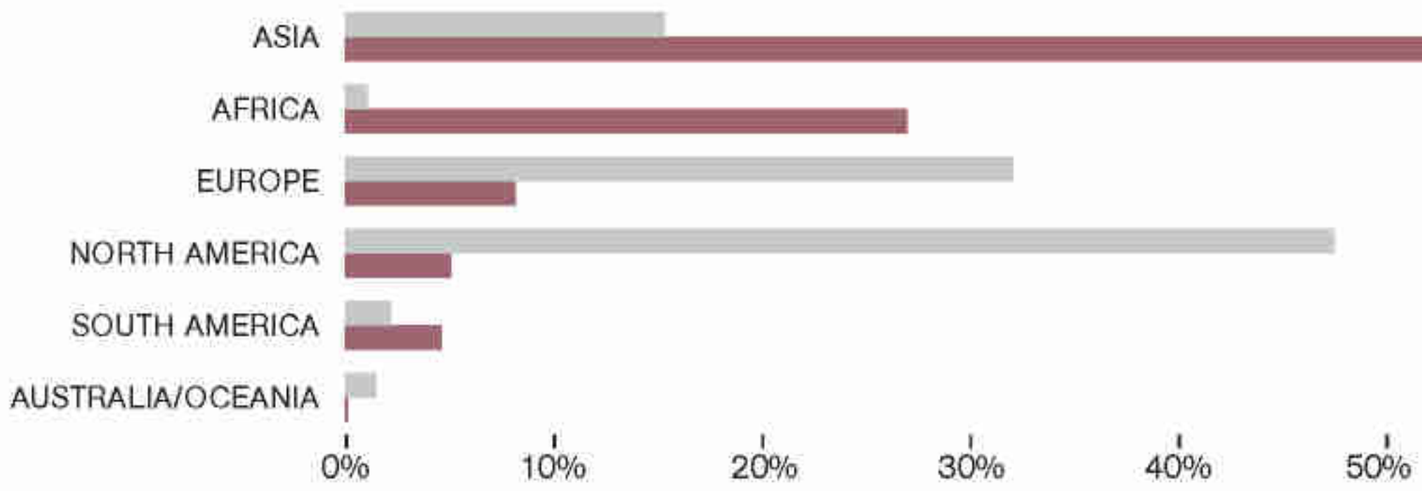
PER 1,000 PEOPLE

- 30 to 55
- 15 to 30
- 10 to 15
- 5 to 10
- 2.5 to 5
- Fewer than 2.5
- No data



FEWEST RESOURCES, GREATEST NEED

- Percentage of world's health expenditure
- Percentage of world's burden of disease (measured in total number of years of life lost to disability or premature death)



JAMKHED COMMUNITY APPROACH

The bottom-up strategy of the Jamkhed project relies on the proven ability of village health workers to treat 80 percent of the community's needs (below). Mobile teams of health professionals make supportive rounds as needed. The project's hospital handles all but a small percentage of more complicated medical conditions.

FIRST LEVEL

VILLAGE HEALTH WORKERS

1 PER VILLAGE (ABOUT 1,000 PEOPLE)

Preventive care, monitoring prescribed medicines, obstetrics, pediatrics, health education, water and sanitation issues

80% of patient needs

SECOND LEVEL

JAMKHED HOSPITAL

AVERAGE DISTANCE FROM PROJECT VILLAGES: 60 MILES

Emergency care, general surgery, chronic diseases

15%

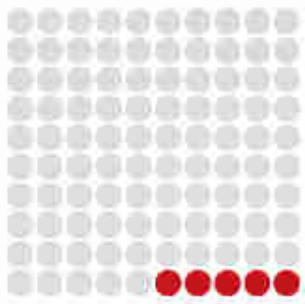
THIRD LEVEL

LARGER HOSPITALS

AVERAGE DISTANCE FROM JAMKHED HOSPITAL: 115 MILES

Specialized care, such as heart surgery or dialysis, provided outside the Jamkhed project by public or private hospitals

5%



M. BRODY DITTEMORE, NG STAFF; ZACH FERRIOLA-BRUCKENSTEIN. SOURCES: WHO (MAP AND TOP GRAPH); JAMKHED COMPREHENSIVE RURAL HEALTH PROJECT

program for more than a few years, the traditional scourges—childhood diarrhea, pneumonia, neonatal deaths, malaria, leprosy, maternal tetanus, tuberculosis—have virtually vanished. Jamkhed villages have far higher rates of vaccination and an infant mortality rate of 22 per 1,000 births, less than half the average for rural Maharashtra. Almost half of all Indian children under age three are malnourished, while in Jamkhed villages there are not enough cases to register. In rural Maharashtra, 56 percent of births are attended by a health worker, compared with 99 percent in Jamkhed villages.

The transformation goes beyond health. In an area once nearly bald of trees, participating villagers have planted millions, and most residents have kitchen gardens that produce spinach, papaya, and other fruits and vegetables. All Jamkhed villages have clean water, and many have pipes carrying it to a pump in every backyard. Most houses have soak pits, a simple drainage system that eliminates standing wastewater.

Sathe and Salve have organized eight women's groups in Jawalke that make these changes happen. They taught members business skills and started a loan pool—everyone ponies up a few rupees, which are lent to one person at a time so she can buy dried fish to sell or goats to raise. When we visited Jawalke, the current campaign was installing toilets. Only 85 of the village's 240 houses had one, and Sathe was trying to organize workdays to get everyone to dig drainage and install toilets at once.

Perhaps the hardest territory to colonize has been inside people's heads, where superstition and stigma prevailed. To villagers in the Jamkhed area, disease came from the gods. When a new mother died from tetanus because a dirty instrument was used to cut the umbilical cord, no one would take care of the child, says Salve. "People said the mother would become a ghost and take the child away." There were superstitions surrounding basic nutrition: Pregnant women were not supposed to eat very much, and new mothers would wait several days before starting to breast-feed. And sufferers of certain diseases, like tuberculosis and leprosy, knowing full well they'd be shunned by their neighbors, didn't dare to openly seek treatment.

Little by little, Salve and Sathe have banished such attitudes, demystifying health. Leprosy, for instance, is now treated like any other disease, which it is—leprosy is actually difficult to catch and curable with medication. The change is visible in the hands of Sakubai Gite. Now 32, she is in her sixth year as a health worker in the village of Pangulghavan. She was in her teens when leprosy took parts of her fingers before it was cured. Her hands are gnarled and deformed.

Those hands are one reason Jamkhed wanted her. "We wanted to show that a cured leprosy patient can be a village health worker," Gite said. "Today I am even permitted to deliver babies."

Discrimination against Untouchables underlies much malnutrition, neglect, and disease, but Jamkhed fights back—often mischievously. During the famine of the 1970s, Jamkhed got money to dig wells. The Untouchables, who had to live on the outskirts of their villages, begged Arole to put in two wells for each village: One for the higher caste women, and one in their neighborhood, so Untouchables could use the pump.

Arole said no. He didn't want to foster caste discrimination. He called in an American geologist with a reputation as a diviner to choose the best spot to drill. "Your job," Arole told him, "is to go around the village looking for water—but to find it only where the Untouchables live."

Soon the Untouchables had water at their doorsteps. The higher caste women, who would not normally have gone to those areas, had to break with tradition—water was more important than caste. "When 50 villages were done, people began to wonder why we were only finding water in Untouchable areas," said Arole. "But by then it was too late."

A SHOCK AWAITS US BACK at Kale's mother's house. From the dusty light of the door we see Kale lying on a cloth in the back of the hut with a baby boy between her legs, the cord still connected. A second shock: There is a twin, not yet born.

Salve washes her hands and does a pelvic exam

A shock awaits us: We see Kale lying with a baby boy between her legs. A second shock: There is a twin, not yet born.

while Sathe holds a flashlight. "The [second] child is breech," she announces. "We need to take you to the hospital."

"No, she should deliver here," an old woman pipes up. She is a neighbor, and before Salve and Sathe began working in the village, she worked as a midwife, or *dai.* But she has lost much of her business. Now she has delivered the first twin and wants to deliver the second. Many states in India are trying to train dais, but most lack basic knowledge about prenatal care and delivery.

"Then you take responsibility," Salve snaps at her. She crouches in front of a cooking fire in the yard, holding a razor blade in the fire with a pair of tongs.

"Don't cut the cord," says the midwife. "If you do, the placenta will go up into the heart!"

It's an old superstition; Salve shakes her head. She takes the now sterile razor and cuts the cord. Salve checks Kale again. "I've delivered twins safely before," she tells Kale gently. "But this baby is not in a normal position."

Kale says her labor pains have stopped. It is not a good sign. Over the objections of the dai, she agrees to make the trip to the hospital.

THE MEDICAL BRAIN DRAIN from poor countries is creating new interest in community health workers, but they have been tried before. The giant experiment was the "barefoot doctor" program of China under Mao—workers were trained in preventive and curative health and paid in work points from their commune. China's experiment sparked dozens of smaller village health worker programs in the 1970s and 1980s. The hope was that they would grow to provide a cheap way to improve health for millions. But many failed, and today only a handful survive. In China, some of Mao's health workers became unlicensed pharmacists or village doctors after the dissolution of communes, focusing on curative services—the ones that pay.

Health experts are taking a hard look at the failures of decades ago, and have diagnosed two fatal problems. Many programs simply stranded their health workers without adequate training, support, or supervision. Also, most of the old programs were too top-down. The villagers themselves didn't choose what problems to attack, nor learn the skills to take over the job. As a result, the health improvements lasted only as long as an outside group was there with money.

Jamkhed, by contrast, has done both things right. It provides an ongoing weekly link for the village health worker to the hospital, a mobile team, a source of drugs and supplies, new skills and knowledge, and perhaps most important, it keeps her in touch with her fellow village health workers, which helps her stay motivated. Also, Jamkhed's health workers train villagers to diagnose and solve their own problems. "It is unique in truly getting people's involvement," says Carl E. Taylor, a professor emeritus at the Bloomberg School of Public Health at Johns Hopkins University in Baltimore, and the world's foremost guru of community health programs. Taylor was the Aroles' teacher. "They were among the most stubborn students I had," he says. "They rejected anything that gave decision-making to the professionals and didn't involve the people."

Elsewhere, successful village health worker programs have grown to be enormous. Nepal's government uses a vast network of volunteer village women, for instance. And the Bangladesh Rural Advancement Committee, or BRAC, runs what is essentially a substitute for a government health care system, with 70,000 village health workers in 70,000 villages. "Small is beautiful, but big is necessary," says Mushtaque Chowdhury, a BRAC executive director.

But Jamkhed is still an Arole production, now run by Shobha and her brother Ravi, an M.B.A. It currently works in just 120 villages, and the mobile team actively visits only 45 of

Sarubai Salve

THE HUMAN TOUCH

After a long, bumpy ride to the hospital in the city of Jamkhed, 24-year-old Rani Kale strains to deliver a baby. At her side, health worker Sarubai Salve reaches out to help ease the pain. In years past, women often died during delivery, and infant mortality was high. Such tragedies were seen as the will of the gods. "There were so many superstitions," says Salve, and much prejudice against Untouchable women like her. Discrimination "was the hardest for me, and the hardest to fight," says Salve. But fight she did. "I gave people love and affection. Slowly casteism goes away."

With a gentle stroke, a song, and some breast-feeding tips, health worker Surekha Sadafule brightens the day for Intaj Pathan and her baby Arbaaz, and also for herself. “With knowledge, we get prestige and respect,” she says. “We are valued in the community.”

Babai Sathe

DREAMING BIG

Born in 1961, she was the third of 11 children. To help feed her family, she worked on a farm. At age ten she was married to a man who beat her regularly. At 16 she contemplated suicide, but was saved by village health workers, who gave her a job—and hope. Today Babai Sathe is the *sarpanch,* or leader, of Jawalke. Adorning her office is a picture of Bhimrao Ramji Ambedkar, an Untouchable revered for his struggle against discrimination. Her life, says Sathe, "is like a dream."

them. Why has Jamkhed not scaled up? Ravi and Shobha argue that it has, just in other ways. It has added services—for example, micro-lending—and extends its reach through training. Jamkhed has given courses to 18,000 Indians and 2,000 others from 100 countries, and Jamkhed's staff travels to teach organizations elsewhere. There are small programs all over the world, from Nepal to Brazil, that use Jamkhed's principles, and the entire Indian state of Andhra Pradesh is adopting Jamkhed's methods, having sent thousands of government workers to Jamkhed for training.

Today, because of Jamkhed's business training and small business grants, its village health workers are no longer particularly poor. Salve, for instance, is one of the richer women in her village. She sells bangles and earrings, owns two houses, a flour mill, and, she proudly says, 15 saris; she also has a Jeep she rents out. This is a good strategy—the wealthier the health worker, the more weight she carries in the village. But it isn't the whole story. Perhaps the real secret of Jamkhed is how it motivates poor, sometimes destitute, women with overwhelming burdens to spend hours of their day on work that offers them no financial remuneration other than the occasional gift of a papaya from a grateful patient. Something clearly does. Most Jamkhed health workers are lifers. Very few leave.

The real benefits, the women say, cannot be measured in rupees. "When I started, I had no support from anyone, no education, no money," said Sathe. "I was like a stone with no soul. When I came here they gave me shape, life. I learned courage and boldness. I became a human being."

In 2005 Babai Sathe, Untouchable, was elected the *sarpanch*—village leader—of Jawalke.

WITHIN MINUTES of Kale's agreement to go to the hospital, the driver brought the Jamkhed van around to the house. Sathe helped her in, along with a posse of women and, bizarrely, a hitchhiker in need of a ride. Kale's father and her four-year-old son sat on the floor in the front of the van. The new baby was on someone's lap.

The road was paved, but only a lane and a half wide. Each time a truck or bus came toward us, we swerved off the road. We passed bullock carts; the van's horn sounded like it was stuck in the "on" position. Salve wiped Kale's face and gave her water, and 45 minutes later we were at Jamkhed's hospital, met by three women with a gurney and whisked into the delivery room. Salve and Sathe were on either side of Kale, holding her legs and comforting her. She was still not having contractions, so a doctor gave her an injection of Pitocin to start them.

A nurse retrieved a fetal heart monitor, contained in a briefcase. Sathe held the briefcase while a nurse pushed the probe over Kale's belly. The only sound in the room was the machine's whooshing. Sathe's eyes darted around the room as the probe moved, not daring to meet Kale's. An eternity passed. There was no heartbeat.

The dead baby was a girl. Although in many Indian families a stillborn girl is no cause for sorrow, Kale felt differently. "I already had one boy," she said later, cradling her second one. "I really did want a girl." But the baby boy was healthy, born just under seven pounds.

Could the girl have been saved? Probably—if Kale had gotten a hospital sonogram at some point during the pregnancy. "We would have detected the high-risk pregnancy and had her give birth here," said Shobha. "But sometimes families are not cooperative, despite encouragement."

Seldom, however, if they are from Jawalke. In the end, the biggest health improvement brought by Sarubai Salve and Babai Sathe to this village is not the impending toilets, vaccinated children, backyard water pumps, vegetable gardens, or any other visible stuff. It is that the women of Jawalke know what constitutes a better life. And now they demand it. When Salve was at Kale's after the first baby was born, three women had gathered on the edge of the property—all young, all pregnant. They were looking for Salve for their checkups.

She nodded to them; she had her hands full; they would have to wait for now.

But tomorrow, they knew, she would come around. □

VISIONS OF MARS

ROBOT EXPLORERS TRANSFORM A DISTANT OBJECT OF WONDER INTO INTIMATE TERRAIN.

Reminiscent of earthly wilderness, hinting at Earthlike geology, the jagged rim of Victoria Crater (left) appears in a near true-color image taken by the rover Opportunity. A color-enhanced satellite view (below, with the promontory at left boxed in white) highlights details of the half-mile-wide crater. With two rovers, a lander, and three orbiters surveying Mars, our view—like our red planet obsession—has never been clearer.

NASA/JPL/CORNELL UNIVERSITY (LEFT); NASA/JPL/UNIVERSITY OF ARIZONA/CORNELL UNIVERSITY/OHIO STATE UNIVERSITY

Bright in this false-color image, deposits of water ice, alternating with bands of dark sand, stairstep from the top of a scarp (far left) into a 2,000-foot-deep canyon. The layers likely accumulated over millions of years during periods similar to ice ages on Earth. Such deposits will help scientists unravel the history of climate change on Mars.

NASA/JPL/UNIVERSITY OF ARIZONA

BY JOHN UPDIKE

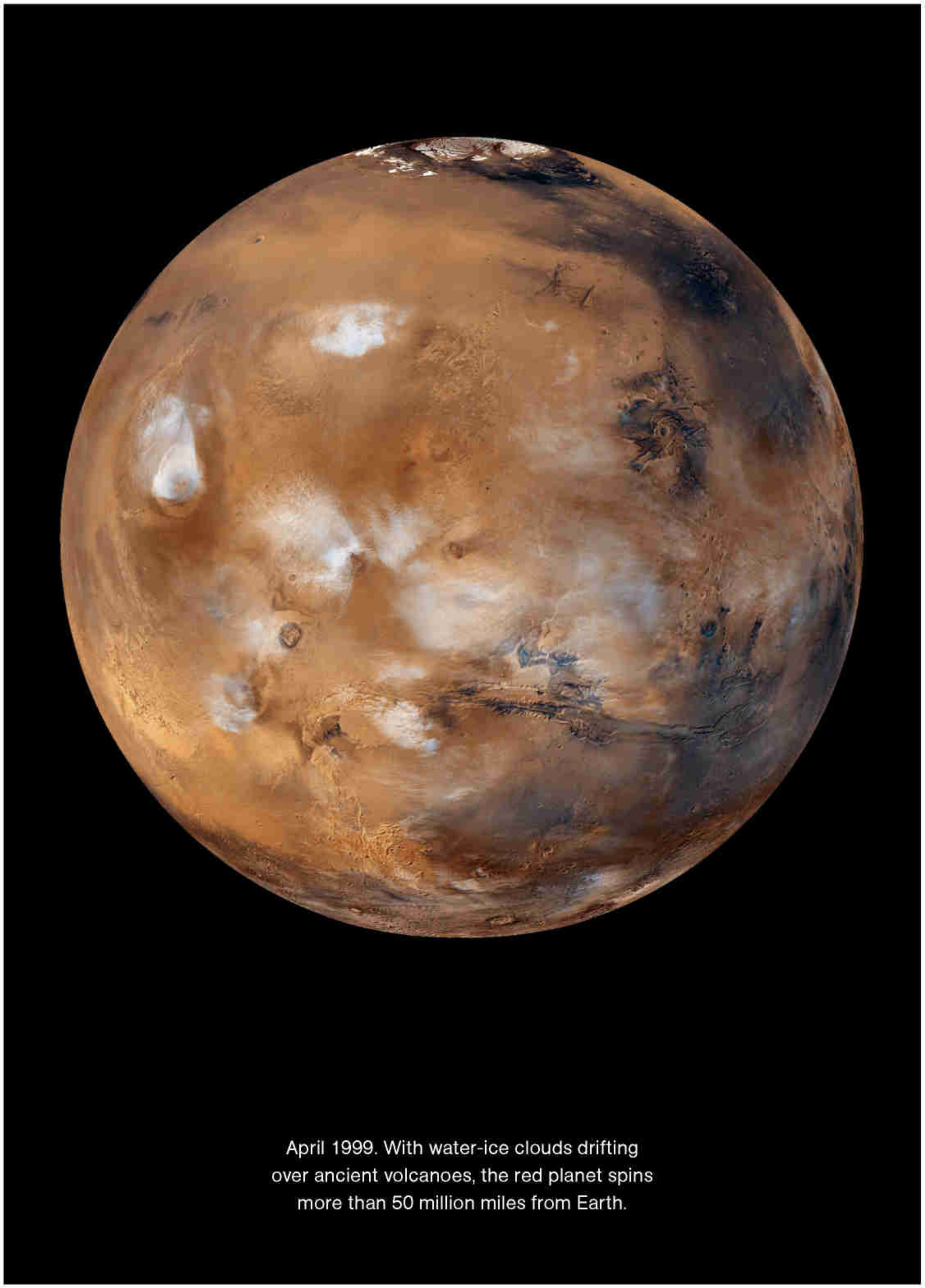
MARS HAS LONG EXERTED A PULL on the human imagination. The erratically moving red star in the sky was seen as sinister or violent by the ancients: The Greeks identified it with Ares, the god of war; the Babylonians named it after Nergal, god of the underworld. To the ancient Chinese, it was Ying-huo, the fire planet. Even after Copernicus proposed, in 1543, that the sun and not the Earth was the center of the local cosmos, the eccentricity of Mars's celestial motions continued as a puzzle until, in 1609, Johannes Kepler analyzed all the planetary orbits as ellipses, with the sun at one focus.

In that same year Galileo first observed Mars through a telescope. By the mid-17th century, telescopes had improved enough to make visible the seasonally growing and shrinking polar ice caps on Mars, and features such as Syrtis Major, a dark patch thought to be a shallow sea. The Italian astronomer Giovanni Cassini was able to observe certain features accurately enough to calculate the planet's rotation. The Martian day, he concluded, was forty minutes longer than our twenty-four hours; he was only three minutes off. While Venus, a closer and larger planetary neighbor, presented an impenetrable cloud cover, Mars showed a surface enough like Earth's to invite speculation about its habitation by life-forms.

Increasingly refined telescopes, challenged by the blurring effect of our own planet's thick and dynamic atmosphere, made possible ever more detailed maps of Mars, specifying seas and even marshes where seasonal variations in presumed vegetation came and went with the fluctuating ice caps. One of the keenest eyed cartographers of the planet was Giovanni Schiaparelli, who employed the Italian word *canali* for perceived linear connections between presumed bodies of water. The word could have been translated as "channels," but "canals" caught the imagination of the public and in particular that of Percival Lowell, a rich Boston Brahmin who in 1893 took up the cause of the canals as artifacts of a Martian civilization. As an astronomer, Lowell was an amateur and an enthusiast but not a crank. He built his own observatory on a mesa near Flagstaff, Arizona, more than 7,000 feet high and, in his own words, "far from the smoke of men"; his drawings of Mars were regarded as superior to Schiaparelli's even by astronomers hostile to the Bostonian's theories. Lowell proposed that Mars was a dying planet whose highly intelligent inhabitants were combating the increasing desiccation of their globe with a system of irrigation canals that distributed and conserved the dwindling water stored in the polar caps.

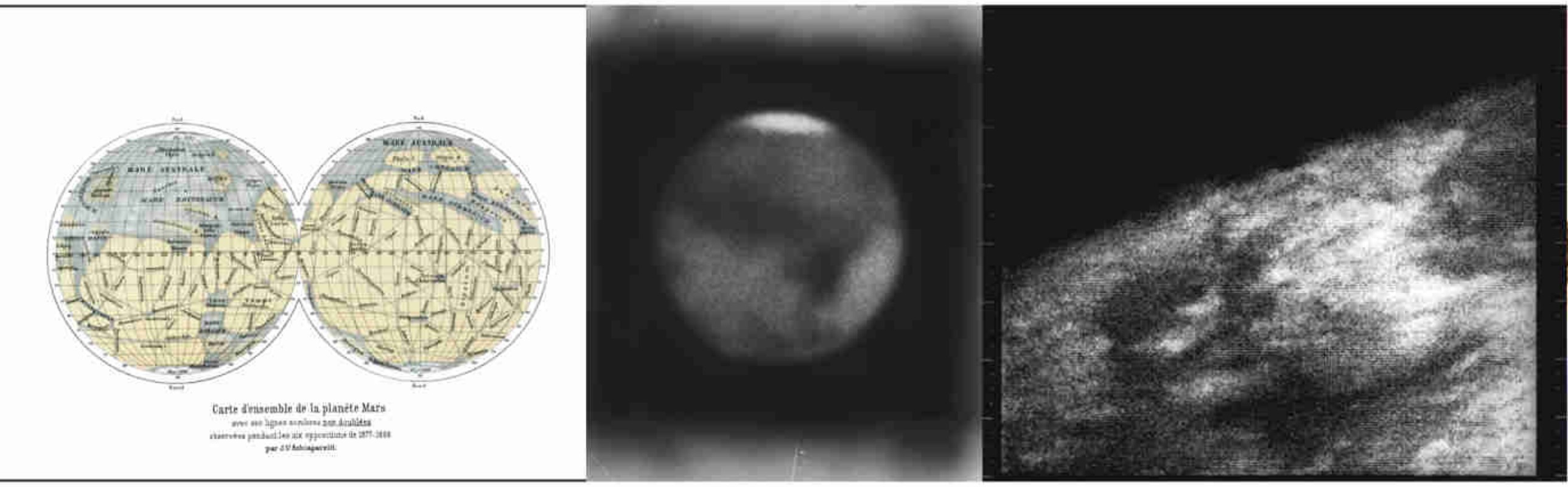
This vision, along with Lowell's stern Darwinism, was dramatized by H. G. Wells in one of science fiction's classics, *The War of the Worlds* (1898). The Earth-invading Martians, though hideous to behold and merciless in action, are allowed a dollop of dispassionate human sympathy. Employing advanced instruments and intelligences honed by "the immediate pressure of necessity," they enviously gaze across space at "our own warmer planet, green with vegetation and grey with water, with a cloudy atmosphere eloquent of fertility, with glimpses through its drifting cloud wisps of broad stretches of populous country and narrow, navy-crowded seas."

John Updike's fiction and poetry have long revealed an interest in science. His latest novel is titled The Widows of Eastwick.



April 1999. With water-ice clouds drifting
over ancient volcanoes, the red planet spins
more than 50 million miles from Earth.

NASA/JPL/MALIN SPACE SCIENCE SYSTEMS



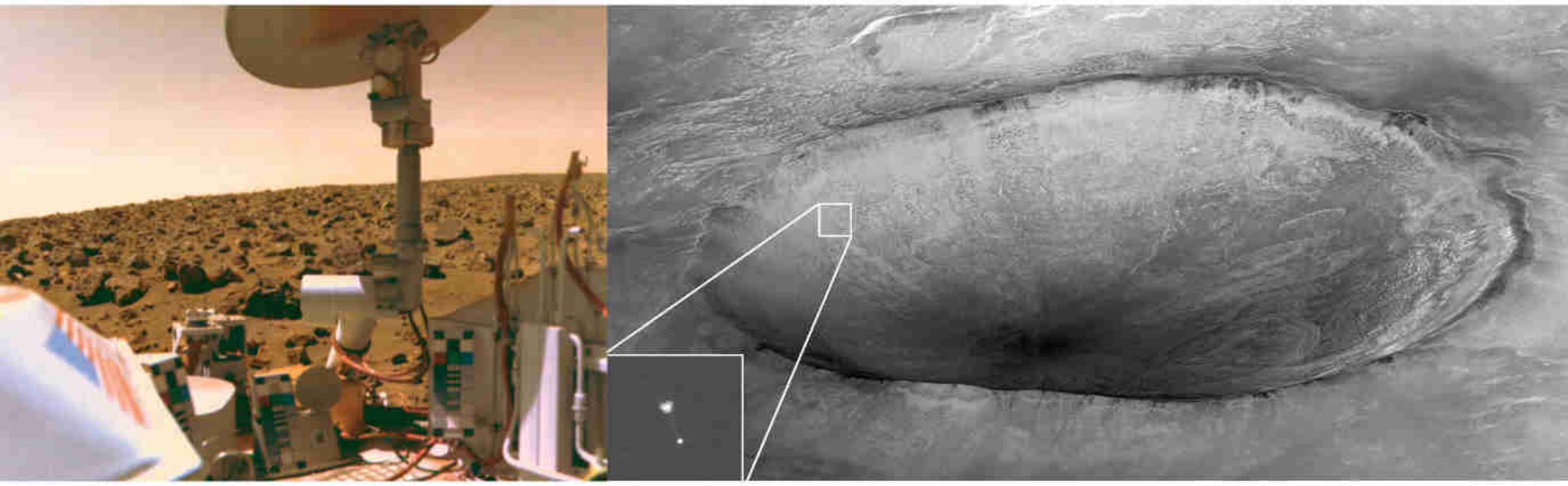
Italian Giovanni Schiaparelli drew one of the first maps of Mars in the late 19th century, naming seas and using the word *canali* to describe linear streaks on the surface. American Percival Lowell took an early photo of the planet (center) around 1907 and, believing the streaks were canals, dreamed of Martian civilizations. In 1965 the Mariner 4 probe captured a close-up (right)—but no sign of life or liquid water.

In the coming half century of Martian fancy, our neighboring planet served as a shadowy twin onto which earthly concerns, anxieties, and debates were projected. Such burning contemporary issues as colonialism, collectivism, and industrial depletion of natural resources found ample room for exposition in various Martian utopias. A minor vein of science fiction showed Mars as the site, more or less, of a Christian afterlife; C. S. Lewis's *Out of the Silent Planet* (1938) invented an unfallen world, Malacandra. Edgar Rice Burroughs's wildly popular series of Martian romances presented the dying planet as a rugged, racially diverse frontier where, in the words of its Earthling superhero John Carter, life is "a hard and pitiless struggle for existence." Following Burroughs, pulp science fiction, brushing aside possible anatomical differences, frequently mated Earthlings and Martians, the Martian usually the maiden in the match, and the male a virile Aryan aggressor from our own tough planet. The etiolated, brown-skinned, yellow-eyed Martians of Ray Bradbury's poetic and despairing *The Martian Chronicles* (1950) vanish under the coarse despoilment that human invasion has brought.

But all the fanciful Martian megafauna—Wells's leathery amalgams of tentacles and hugely evolved heads; American journalist Garrett Serviss's 15-foot-tall quasi red men; Burroughs's 10-foot, 4-armed, olive-skinned Tharks; Lewis's beaver-like hrossa and technically skilled pfifltriggi; and the "polar bear-sized creatures" that Carl Sagan imagined to be possibly roaming the brutally cold Martian surface—were swept into oblivion by the flyby photographs taken by Mariner 4 on July 14, 1965, from 6,000 miles away. The portion of Mars caught on an early digital camera showed no canals, no cities, no water, and no erosion or weathering. Mars more resembled the moon than the Earth. The pristine craters suggested that surface conditions had not changed in more than three billion years. The dying planet had been long dead.

Two more Mariner flybys, both launched in 1969, sent back 57 images that, in the words of the NASA release, "revealed Mars to be heavily cratered, bleak, cold, dry, nearly airless and generally hostile to any Earth-style life-forms." But Mariner 9, an orbiter launched in 1971, dispatched, over 146 days, 7,000 photographs of surprisingly varied and violent topography: volcanoes, of which the greatest, Olympus Mons, is

FROM LEFT: OBSERVATOIRE CAMILLE FLAMMARION, ARCHIVES CHARMET/BRIDGEMAN ART LIBRARY; LOWELL OBSERVATORY, NATIONAL GEOGRAPHIC STOCK; NATIONAL SPACE SCIENCE DATA



In 1976 NASA's Viking landers transmitted color images of the Martian surface and scooped samples of soil (left). Twenty-one years later a mobile vehicle, Sojourner, arrived. Today rovers Spirit and Opportunity roam near the equator while a new lander, Phoenix—photographed from an orbiter overhead as it parachuted to the northern arctic plain in May 2008 (right)—has joined them to investigate water and ice.

13 miles high, and a system of canyons, Valles Marineris, that on Earth would stretch from New York City to Los Angeles. Great arroyos and tear-shaped islands testified to massive floods in the Martian past, presumably of water, the sine qua non of life as Earth knows it. In 1976 the two Viking landers safely arrived on the Martian surface; the ingenious chemical experiments aboard yielded, on the question of life on Mars, ambiguous results whose conclusions are still being debated into the 21st century.

In the meantime, our geographical and geological intimacy with Mars grows. The triumphant deployment of the little Sojourner rover in 1997 was followed in 2004 by the even more spectacular success of two more durable rovers, Spirit and Opportunity. In four years of solar-powered travels on the red planet, the twin robots have relayed unprecedentedly detailed images, including many clearly of sedimentary rocks, suggesting the existence of ancient seas. The stark, russet-tinged photographs plant the viewer right on the surface; the ladderlike tracks of Spirit and Opportunity snake and gouge their way across rocks and dust that for eons have rested scarcely disturbed under salmon pink skies and a pearlescent sun. In this tranquil desolation, the irruption of our live curiosity and systematic purpose feels heroic.

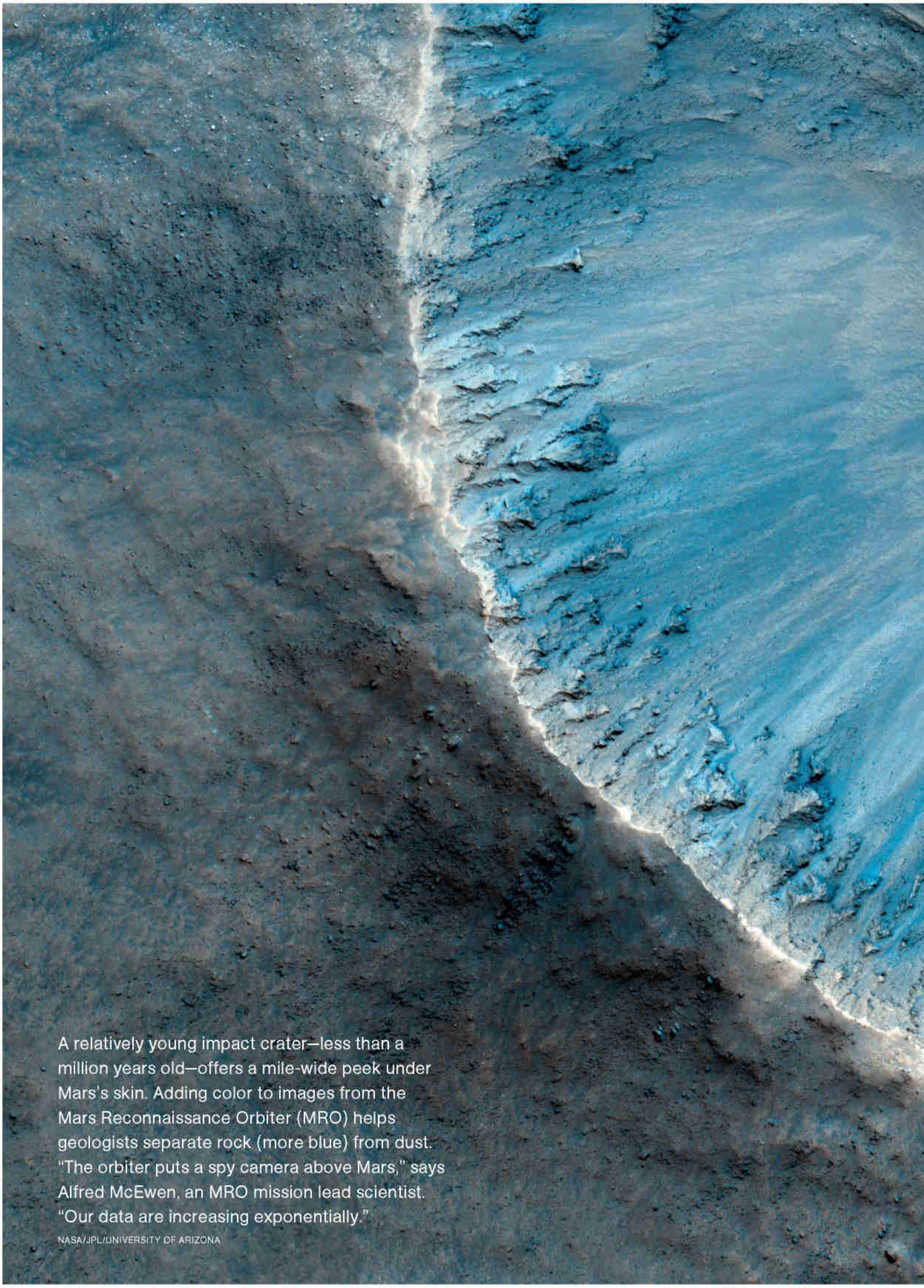
Now the Phoenix mission, with its surpassingly intricate arm, scoop, imagers, and analyzers, takes us inches below the surface of dust, sand, and ice in Mars's north polar region. Spoonfuls of another planet's substance, their chemical ingredients volatilized, sorted, and identified, become indexes to cosmic history. Meanwhile, the Mars Reconnaissance Orbiter, the newest of three operational spacecraft circling the planet, feeds computers at the University of Arizona with astoundingly vivid and precise photographs of surface features. Some of these false-color images appear totally abstract, yet they yield to knowledgeable eyes riches of scientific information.

The dead planet is not so dead after all: Avalanches and dust storms are caught on camera, and at the poles a seasonal sublimation of dry ice produces erosion and movement. Dunes shift; dust devils trace dark scribbles on the delicate surface. Whether or not evidence of microbial or lichenous life emerges amid this far-off flux, Mars has become an ever nearer neighbor, a province of human knowledge. Dim and fanciful visions of the twinkling fire planet have led to panoramic close-ups beautiful beyond imagining.

CENTER/NASA; NASA/JPL; NASA/JPL/UNIVERSITY OF ARIZONA

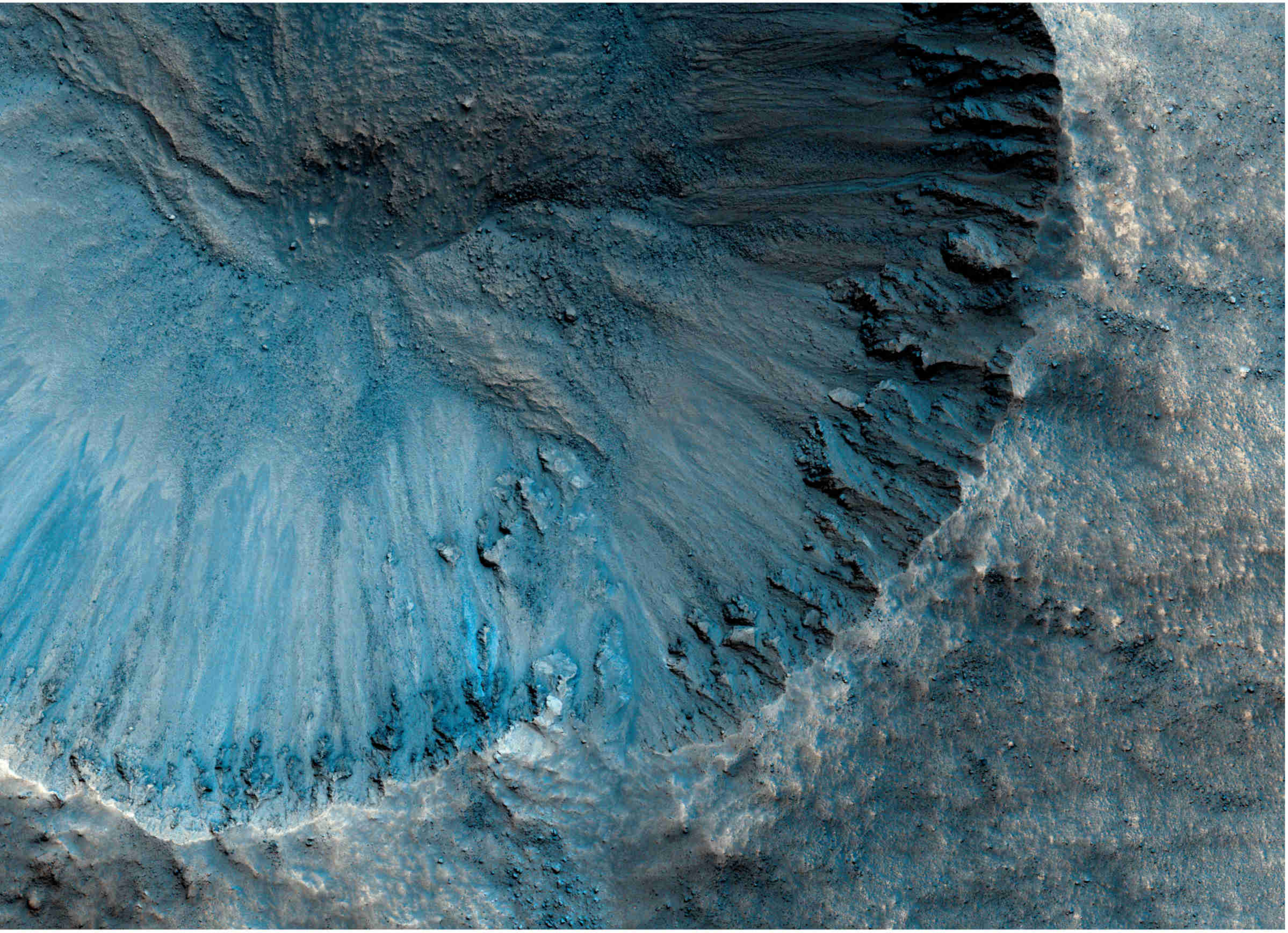
Rolling away from a crater at two feet a minute (or less), Opportunity plotted this path largely without human help. Software upgrades beamed to the rovers after landing lets them identify and avoid obstacles autonomously. Engineers thought cold and dust might shut down the pair within 90 days. But as of September 2008, 57 months after their work began, both rovers were still going strong.

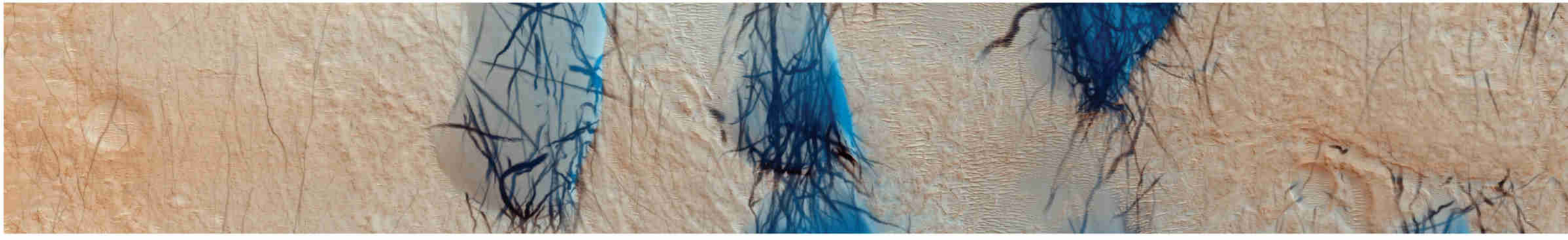
NASA/JPL/CORNELL UNIVERSITY

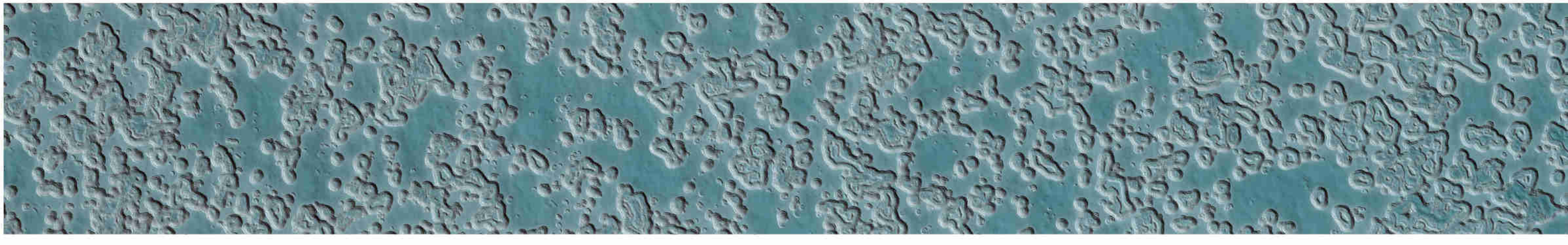


A relatively young impact crater—less than a million years old—offers a mile-wide peek under Mars's skin. Adding color to images from the Mars Reconnaissance Orbiter (MRO) helps geologists separate rock (more blue) from dust. "The orbiter puts a spy camera above Mars," says Alfred McEwen, an MRO mission lead scientist. "Our data are increasing exponentially."

NASA/JPL/UNIVERSITY OF ARIZONA

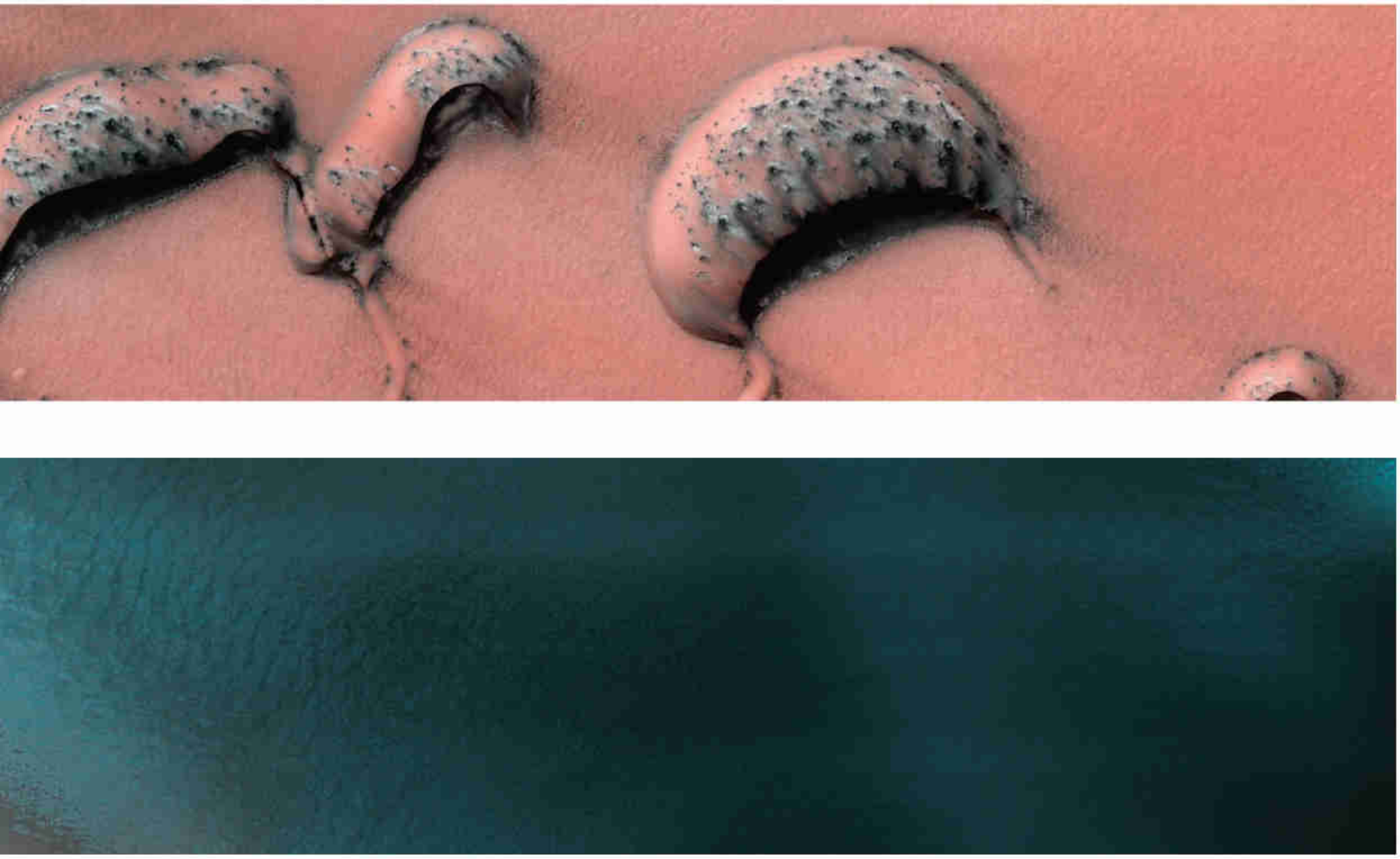






The textures of Mars appear in false-color images taken by the MRO, like strips cut from abstract paintings. From top to bottom: Sand dunes show streaks of dust and carbon dioxide frost being blown by the wind. In Russell Crater mysterious gullies scar the face of a brown dune. It's unclear how they form, but sublimation—the instant transformation of carbon dioxide frost into gas when surface temperatures rise—could play a role. "We don't have anything on Earth that compares to this process," says NASA's Candice Hansen-Koharcheck. Across the tops of other dunes,

NASA/JPL/UNIVERSITY OF ARIZONA (ALL)



dark tracks, looking like clumps of hair, appear where dust devils have scoured away beige sediments. And at the south pole, pits that grow wider each year pockmark a sheet of dry ice. Thermal evidence suggests a layer of water ice may lie below the slab.

Sunset on Mars casts bluish light over the distant horizon. It's a deceptively familiar view. We barely know our neighbor, especially when it comes to the big question: life. "Mars was a habitable world at some point early in its history," says Jim Bell, a planetary scientist at Cornell University. "We don't know exactly when, and we don't know precisely where. Future missions will have to figure that out." □

NASA/JPL/TEXAS A&M/CORNELL UNIVERSITY

The

MAN WHO WASN'T DARWIN

ALFRED RUSSEL WALLACE

charted a great dividing line in the living world—and found his own route to the theory of evolution.

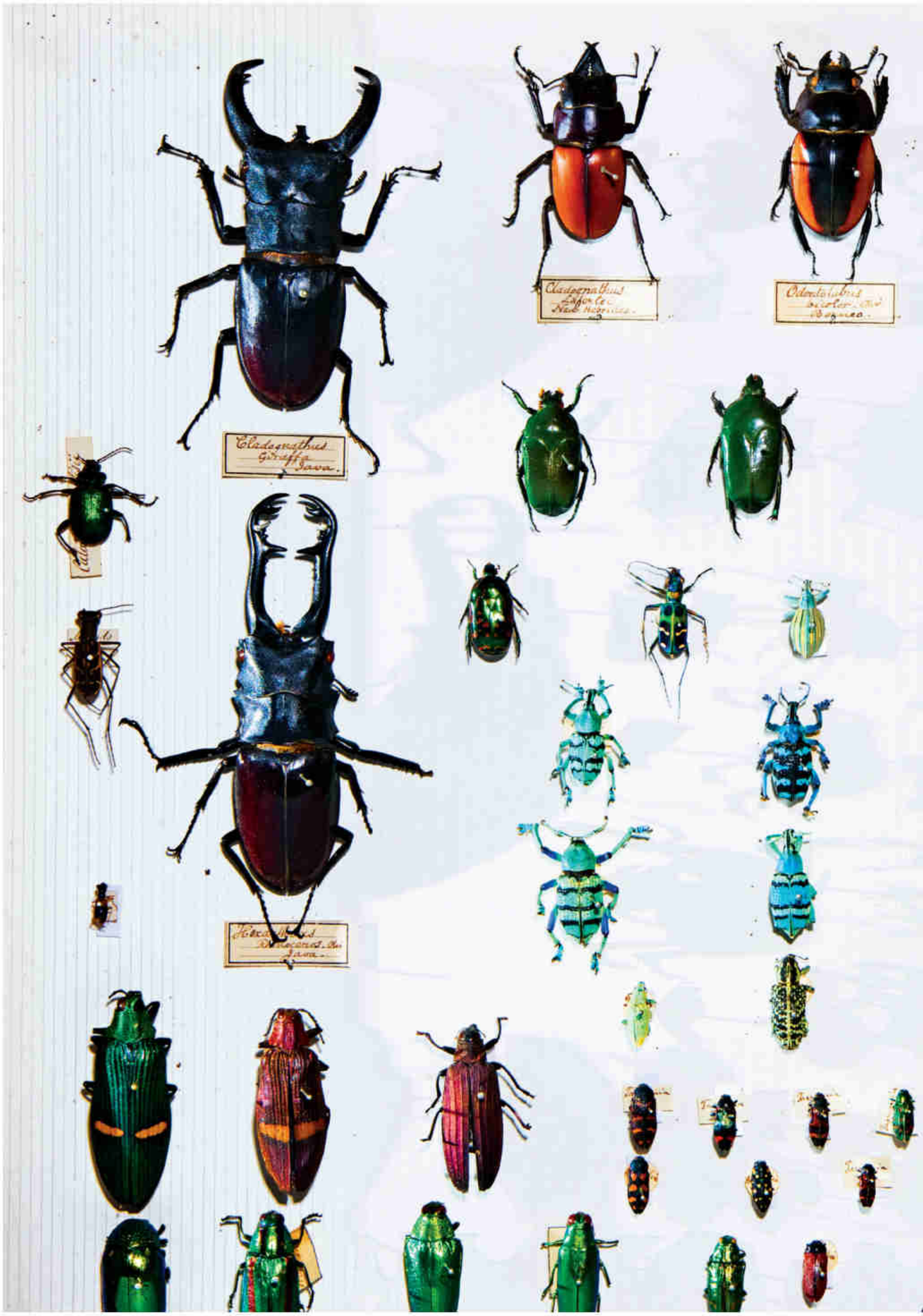
By David Quammen · Photographs by Robert Clark

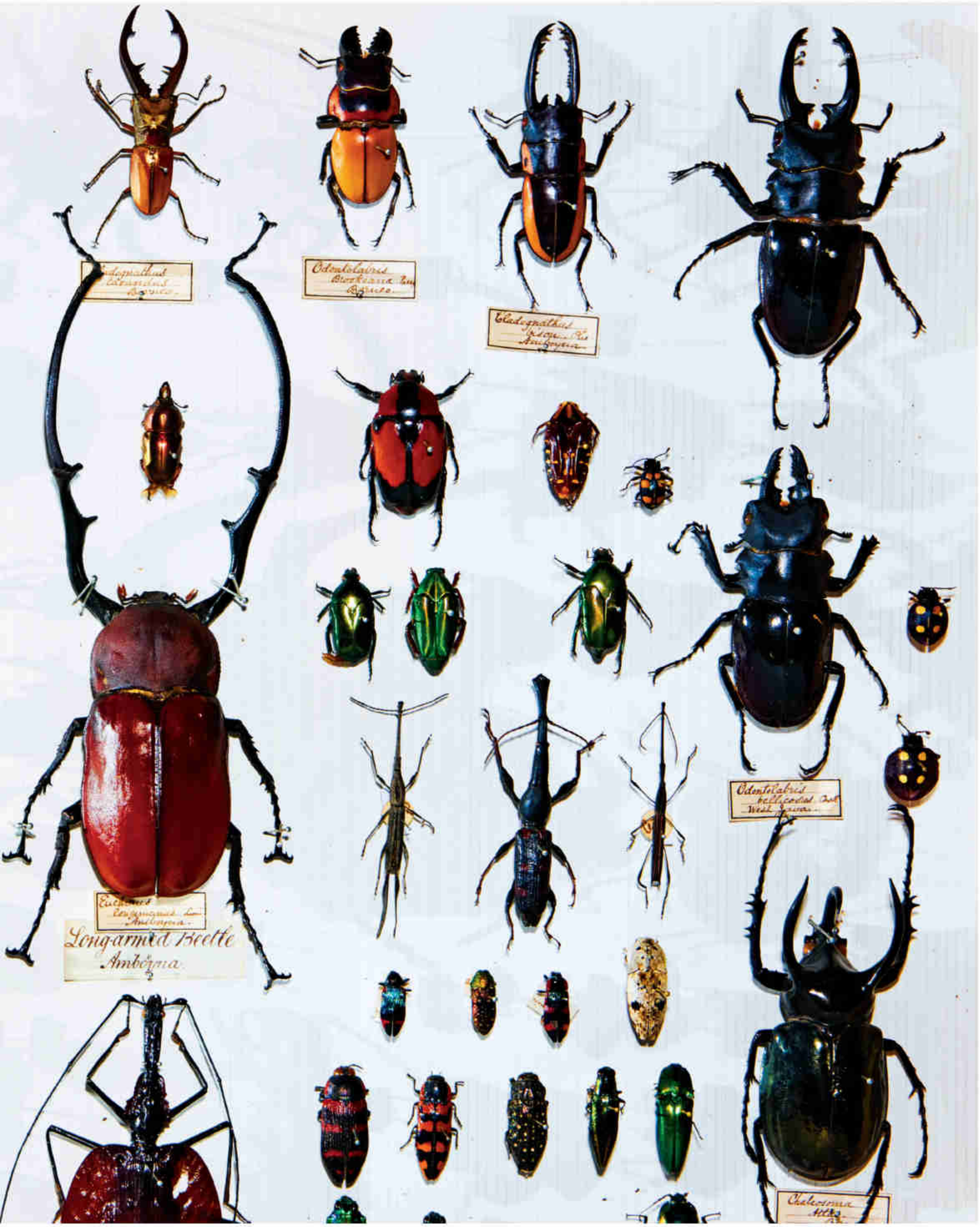
West of the line, in Sumatra, Wallace saw a species of dead-leaf butterfly whose closest relatives are African and Asian.

SOPHIA M. SACHS BUTTERFLY HOUSE, MISSOURI BOTANICAL GARDEN; CLEVELAND METROPARKS ZOO (OPPOSITE)

THE WALLACE LINE

East of the line, in the Moluccas, are found cassowaries, giant flightless birds characteristic of New Guinea and Australia.



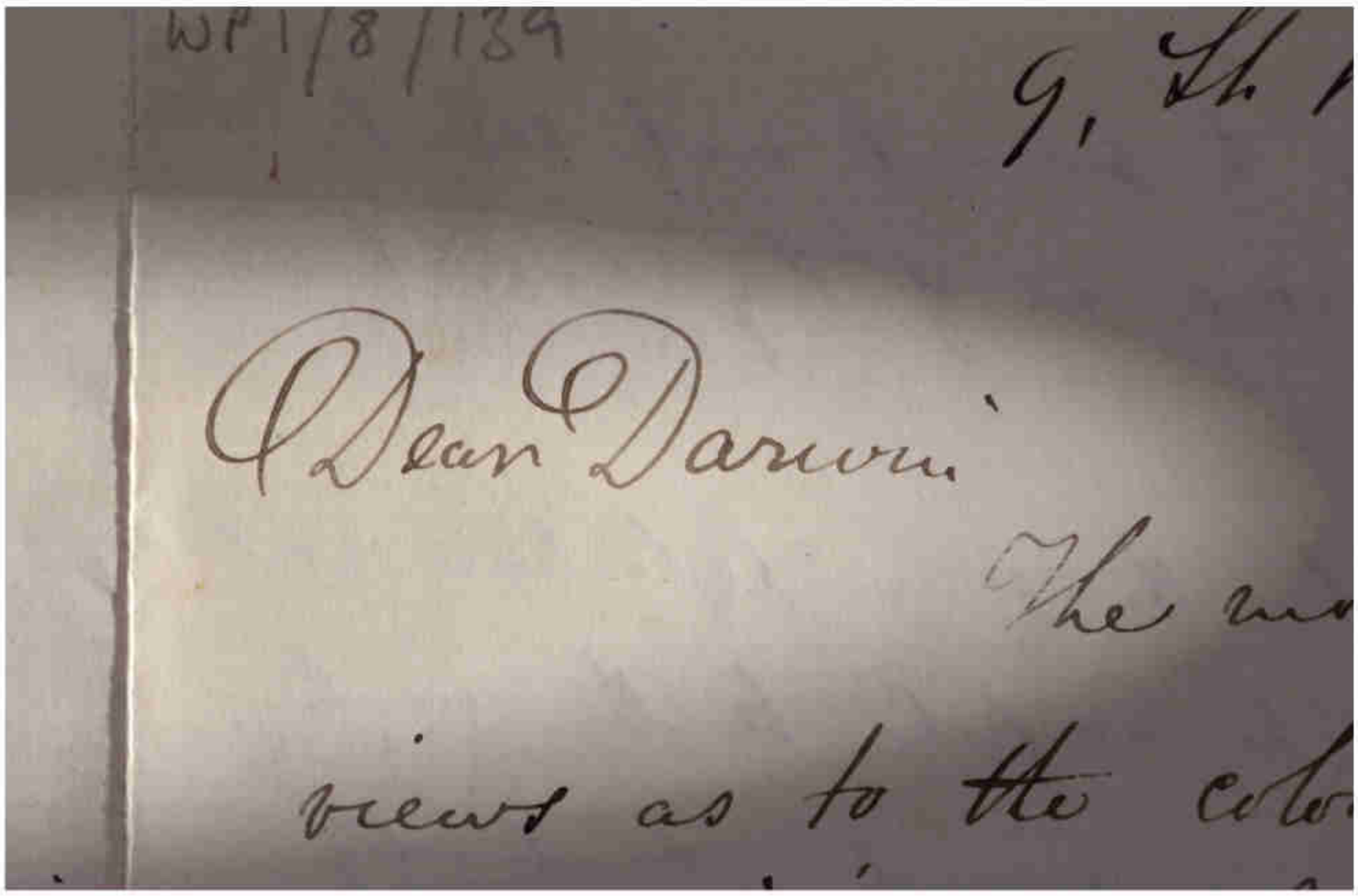


Wallace, like Charles Darwin, began as a young fancier of British beetles. Then he traveled far, both in distance and intellectually, as a commercial collector. Specimens such as these, from his personal collection, helped reveal the story of species' origins.

NATURAL HISTORY MUSEUM, LONDON

During a rainy season in northern Borneo early in 1855, Wallace lived in a little house near this mountain. It was too wet for collecting, so he holed up and pondered the patterns of species distribution he had seen throughout his tropical travels.

MATTIAS KLUM



At the time he conceived his evolutionary theory, in 1858, Wallace knew Darwin only from a distance; later they would be friends who addressed each other informally (above). Wallace (below, around the time of his return to England, in 1862) never became an insider in British science.

NATURAL HISTORY MUSEUM, LONDON (BOTH)

W

THE ISLAND OF TERNATE is a small, graceful volcanic cone rising leafy green from the sea in northeastern Indonesia, 600 miles east of Borneo. Although it's an out-of-the-way place, tucked between much larger islands, Ternate was once an entrepôt of the Dutch empire, from which spices and other precious tropical commodities traveled westward by ship. Today its busy dock area, its fruit and fish markets, its mosques, its old forts, its sultan's palace, and its tidy concrete houses are strung like carousel lights along a single ring road that traces the coastline. Its upland slopes are mostly forested and unpopulated, and in those woods, if you're lucky, you might still spot a certain resplendent bird, emerald-breasted, with two long white plumes dangling capelike from each shoulder, whose scientific name—*Semioptera wallacii*—honors the man who first brought it to scientific attention. That man was Alfred Russel Wallace, a young English naturalist who did fieldwork throughout the Malay Archipelago in the late 1850s and early '60s. What you won't see on Ternate is any grand plaque or statue commemorating Wallace's place in scientific history or the fact that, from this little island, on March 9, 1858, he sent off a highly consequential letter, aboard a Dutch mail steamer headed westward.

The letter was addressed to Mr. Charles Darwin. Along with it Wallace enclosed a brief paper titled "On the Tendency of Varieties to depart indefinitely from the Original Type." It was the product of two nights' hasty scribbling, which followed a moment's epiphany during a fever, which in turn followed more than ten years of speculation and careful research. What the paper described was a theory of evolution (though not under that name) by natural selection (not using that phrase) remarkably similar to the theory that Darwin himself, then an eminent naturalist of rather conventional reputation, had developed but hadn't yet published.

This is a classic episode in the history of science, a story of a coincidence and its aftermath, told and retold in books about how evolutionary biology came to be: the near simultaneous formulation of what we now think of as Darwin's theory by Darwin himself and a young upstart, Alfred Russel Wallace. Classic or not, many people nowadays are unaware of it. Wallace, famed during his life as Darwin's junior partner and for his other contributions to science and social thought, fell into obscurity after his death, in 1913. In recent decades his renown has been revivified, both by scholars who mine every aspect of Darwin's life—Wallace was a crucial part—and by a few popular writers. His grave marker, in the village of Broadstone, no longer stands crumbling and overgrown by tree limbs. His portrait now hangs, along with an older one of Darwin, in the meeting room of the Linnean Society in London, the same scientific society to which the Darwin-Wallace co-discovery was announced 150 years ago, on the evening of July 1, 1858. His writings, on subjects from evolutionary theory and social justice to life on Mars, are coming back into print or turning up on the Web. He is recognized among science historians as a founder of evolutionary biogeography (the study of which species live where, and why), as a pioneer of island biogeography in particular (from which the science of conservation biology grew), as an early theorist on adaptive mimicry, and as a prescient voice on behalf of what we now call biodiversity. That is, he's a towering figure in the transition from old-fashioned natural history to modern biology. During his years afield Wallace was also a prolific collector, a ruthless harvester of natural wonders; his insect and bird specimens added richly to museum holdings and the discipline of taxonomy. Still, most people who know of Alfred Russel Wallace know him only as Charles Darwin's secret sharer, the man who co-discovered the theory of evolution by natural selection but failed to get an equal share of the credit.

Wallace's story is complicated, heroic, and perplexing. Besides being one of the greatest field biologists of the 19th century, he was a man of crotchety independence and lurching enthusiasms, a restless soul never quite satisfied with the place in which he lived, a believer in spiritualism and séances, a devotee of phrenology, a dabbler in mesmerism, a later apostate from Darwinian theory when it came to the development of the human brain, an opponent of smallpox vaccination, and an advocate of nationalizing large private landholdings, who by these and other eccentricities gave his detractors some grounds for dismissing him as a crank. Which they did. The question that no scholar or biographer has adequately answered is: How to reconcile such brilliant achievements, radical convictions, and incautious zealotries within one human character—the character of a consummate empiricist and field naturalist? If he hadn't existed, this Alfred Wallace, it would have taken a very peculiar Victorian novelist to create him.

THE FIRST CARDINAL point in the biography of Alfred Wallace is that for him, as for Will Shakespeare but not for Charles Darwin, impecuniousness was the mother of invention. He was a curious lad from a family with no money. At age 14, in 1837, having left school, he went to work. Darwin, at that time a young gentleman of 28 with a wealthy father who subsidized his adventures, had just arrived home aboard the *Beagle*.

Wallace was largely self-taught, frequenting town libraries and workingmen's institutes during the decade he labored as a land surveyor, a builder, and a schoolteacher in the city of Leicester. Early on he discovered the life and writings of Robert Owen, the founder of British socialism, who became his "first teacher in the philosophy of human nature," as Wallace later recalled, and an influence toward his own socialist convictions. During his surveying period, spent largely in rural Wales, he got interested in nature by way of botany, taking long walks across the moors and mountains, training himself to identify plant families with help from a cheap paperback guide. His teaching job left him time for an eclectic syllabus of personal reading that included Humboldt's *Personal Narrative of Travels,* and, most consequentially, Malthus's *Essay on the Principle of Population,* which had catalyzed Charles Darwin's thinking about the struggle for survival and would catalyze Wallace's too. Although Wallace found himself unsuited to teaching, the year at Leicester yielded one memorable event: He became friends with a young man named Henry Walter Bates, a former hosier's apprentice, who introduced him to the joys of beetle collecting.

Books were always important to Wallace, and he testified that two others helped set his course. One was Charles Darwin's *Journal* from the voyage of the *Beagle,* a lively travel narrative that gave almost no hint of evolutionary ideas. The other, more daring and incendiary, was an anonymously authored best seller titled *Vestiges of the Natural History of Creation,* published in 1844, which did offer an evolutionary vision of life on Earth, though not in a form that most discerning readers found persuasive. The prevailing orthodoxy in Western culture was that God had shaped all species through special acts of creation, and that every species was essentially fixed, incapable of varying much from an ideal type. Such fixity was not just a religious dogma but a scientific one; the science philosopher William Whewell, for instance, had recently written: *"Species have a real existence in nature,* and a transmutation from one to another does not exist." In opposition to that view *Vestiges* hypothesized a "law of development" in living creatures, whereby one species is transformed into another by external circumstances, in incremental stages, from simple life-forms to complex ones, up to and including man. The result was adaptation. God still played a role, according to *Vestiges,* but more distantly—as ultimate designer of the process.

The book was a potpourri of interesting facts, absurd factoids, savvy insights, tenuous suppositions, and woozy deductive leaps, which variously satisfied or amused readers ranging from Queen Victoria to John Stuart Mill to Florence Nightingale. Darwin thought it shaky at best. Wallace, younger and more impressionable, saw in it "an ingenious hypothesis" yet to be proved, or maybe not, by further research. For him *Vestiges* represented both "an incitement" to gather natural history data and a provisional theory against which new data could be tested. Thus incited, he and his friend Bates cooked up a plan to go to the Amazon rain forest in quest of such data.

Having almost no money, they paid their expenses by shipping back natural history specimens for sale to museums and private fanciers.

Butterflies, beetles, and birds were mostly what was wanted, and if the creatures were both rare and gorgeous, all the better. Their agent was Samuel Stevens, of Bloomsbury Street in London, a faithful man who would play an enduring role in Wallace's life, linking him to the buyers and eventually to the scientists of England.

Wallace's four-year saga in the Amazon—exploring remote headwater regions along the Rio Uaupés and elsewhere (while Bates traveled separately), making observations, gathering specimens, taking notes, drawing sketches—was a triumph of persistence, invaluable as a training exercise but ending in disaster. He sailed home from Pará (Belém), Brazil, in August 1852, aboard the *Helen,* which caught fire and sank. Wallace survived in a lifeboat, but all the collections he'd brought with him, comprising thousands of insects and probably hundreds of bird skins, were gone. Then the ship by which he was rescued, a dubious tub called the *Jordeson,* met a harrowing storm and almost sank too. "Fifty times since I left Pará have I vowed," Wallace wrote to a friend, "if I once reached England, never to trust myself more on the oceans. But good resolutions soon fade." Within days of limping ashore, Wallace had begun planning his next trip. This time he would go east, into a world of islands.

HIS LONG EXPEDITION to the Malay Archipelago was a much different matter, far more fruitful in its yield of specimens and ideas. Wallace arrived at Singapore in April 1854 and spent the next eight

Wallace was a man of crotchety independence and lurching enthusiasms. If he hadn't existed, it would have taken a very peculiar Victorian novelist to create him.

The tiger is an Asian species that reached Sumatra, Java, and Bali. The Sumatran subspecies still survives in the wild, tenuously, and in zoos (above).

FORT WAYNE CHILDREN'S ZOO

THE WALLACE LINE

Wallace described two great faunal regions and the boundary, defined by a deepwater gap, between them. West of the line, groups such as hornbills, carnivores, primates, and insectivores predominated. Marsupials, cockatoos, birds of paradise, and other distinctive groups predominated to the east. Such patterns in biogeography helped advance his thinking about evolution.

100°
110°
5°N
0°
5°S
10°

MALAY PENINSULA

Argus pheasant

Malacca

+Mount Ophir
July to September 1854

Malayan tapir

Malayan colugo

SINGAPORE
April to June 1854
January to May 1856

WALLACE'S ROUTES
Started at Singapore April 1854
Last returned to Singapore January 1862

SARAWAK

Kuching

Sarawak River

Simunjon (Simunjan)

November 1854 to January 1856

To Bali and Lombock June 1856

S U M A T R A

Sumatran tiger

Siamang gibbon

Sumatran rhinoceros

SUNDA SHELF

Orangutan

Rhinoceros hornbill

Muntok

BANCA (BANGKA)

BILITON (BELITUNG)

Palembang

November 1861 to January 1862

Lobo Raman

Orange-backed woodpecker

Land Bridges
During glacial epochs water was tied up in polar ice, exposing land bridges that intermittently connected Sumatra, Java, and Borneo with the mainland and allowed Asian species to arrive.

Geologic Activity
Volcanic eruptions, elevation and subsidence of landmasses, and tectonic movements have added complexity to patterns of animal distribution.

J A V A S E A

Sunda Strait

Batavia (Jakarta)

Buitenzorg (Bogor)

July to November 1861

Samarang (Semarang)

J A V A

Green junglefowl

Javan rhinoceros
(Indonesian subspecies)

INDO-MALAYAN REGION

During glacial epochs of lowered sea level, ancestral species from southeastern Asia arrived by overland dispersal and then, when the sea rose again, found themselves marooned. With time, some lineages gave rise to new subspecies, such as the Javan rhinoceros.

Species found predominantly west of Wallace's line

Birds (177 species)
- Babblers (57)
- Broadbills (9)
- Bulbuls (29)
- Hornbills (10)
- Tits and titmice (3)
- Trogons (8)
- Pheasants (22)
- Woodpeckers, barbets (39)

Mammals (215 species)
- Carnivores (47)
- Insectivores (27)
- Mouse deer, deer (15)
- Odd-toed ungulates (3)
- Pangolins (2)
- Primates (28)
- Rodents (79)
- Tree shrews (14)

VIRGINIA W. MASON, NG STAFF
RELIEF BY JOHN A. BONNER. ART BY HIRAM HENRIQUEZ, NG STAFF. SOURCES: ALFRED RUSSEL WALLACE, *THE MALAY ARCHIPELAGO* (WOODCUTS) AND *GEOGRAPHICAL DISTRIBUTION OF ANIMALS*; BERNARD MICHAUX; PAPUAWEB PROJECT

AUSTRO-MALAYAN REGION

The major landmasses of Australia and New Guinea, connected as one during low-water epochs, form the region's core area. Marsupials diversified richly on those lands and radiated westward as opportunities arose, with two species of cuscus reaching as far as Celebes, just east of the line.

Species found predominantly east of Wallace's line

Birds (241 species)
- Cassowaries (3)
- Cuckoos (4)
- Kingfishers, bee-eaters (8)
- Megapodes (11)
- Owlet-nightjars (7)
- Parrots, cockatoos (52)
- Perching birds (93)
- Pigeons, doves (13)
- Rails (9)
- Birds of paradise (41)

Mammals (79 species)
- Marsupials
  - Bandicoots (10)
  - Cuscus (16)
  - Sugar gliders (5)
- Placentals
  - Anoa (2)
  - Babirusa (1)
  - Flying foxes, fruit bats (20)
  - Squirrels, rats (25)

ORANGUTAN
Pongo pygmaeus

Two species of orangutan are now known, one on Sumatra and one on Borneo, where Wallace studied it. Both are great apes, closely related to African forms such as chimpanzees and gorillas—and to humans.

The Moluccas
These smaller islands, framed by Gilolo, Bouru, and Ceram, harbor some unique marsupials and birds, including the Moluccan megapode, first identified by Wallace.

Wallacea
This area, including Celebes, the Moluccas, and the Lesser Sunda Islands, is a transitional zone, isolated from both Asia and Australia by deep water. Thirty-six species of mammals and nineteen species of birds are endemic—evolved here and found nowhere else.

Bali and Lombock
Between these islands, so close together, falls a deepwater divide. Wallace noticed that their bird faunas differed dramatically.

New Guinea
New Guinea and the nearby islands contain relatively few mammal species but many endemic species of birds, reptiles, and insects.

More than three dozen bird of paradise species are known, all but two native east of the 100-fathom line (left). Wallace himself discovered one of the exceptions, now called Wallace's standard wing, on Batchian.

BLACK SICKLE-BILLED BIRD OF PARADISE
Epimachus fastuosus

BORNEO
CELEBES SEA
WALLACE'S LINE
Macassar Strait (Makassar Strait)
Tree shrew
Thick-spined porcupine
Otter civet
Green broadbill
Lowland anoa
Babirusa
Bare-backed fruit bat
Sulawesi dwarf cuscus
CELEBES (SULAWESI)
Gulf of Tomini
Menado (Manado)
June to September 1859
MOLUCCA SEA
Morty (Morotai)
Moluccan megapode
Ternate
Tidore
GILOLO (HALMAHERA)
Makian
Kaióa (Kayoa)
Batchian (Bacan)
Many visits to Ternate and adjacent islands between January 1858 and July 1861
Wallace's standard wing
Red bird of paradise
WAIGIOU (WAIGEO)
July to September 1860
Tree kangaroo
Dorey (Manokwari)
April to July 1858
VOGELKOP PENINSULA (JAZIRAH DOBERAI)
Brown dorcopsis
Mysol (Misool)
Magnificent bird of paradise
JOBIE (YAPEN)
Oby (Obi)
SULA-MANGOLA (SULA ISLANDS)
Southern cassowary
Wahai
CERAM
Warus-warus (Waru)
BOURU (BURU)
Amboyna (Ambon)
Many visits between December 1857 and June 1860
Goram (Gorong)
April to May 1860
Matabello Is. (Watubela Is.)
Banda Is.
December 1857
June 1859
April to May 1861
January to July 1857
KE IS. (KAI IS.)
Dobbo (Dobo)
ARU ISLANDS
Palm cockatoo
Greater bird of paradise
Wallace's dasyure
NEW GUINEA
Maros
Macassar (Ujungpandang)
September to December 1856
July to November 1857
The 100-fathom line (600 feet) marks the extent of land bridge.
100 fathoms
FLORIS SEA (FLORES SEA)
DEEP SEA (MORE THAN 100 FATHOMS)
BANDA SEA
Yellow-crested cockatoo
Bileling (Singaraja)
August 1856
Ampanam (Ampenan)
BALI
LOMBOK (LOMBOK)
SUMBAWA
COMODO (KOMODO)
FLORIS (FLORES)
LESSER SUNDA ISLANDS
Blue-eared barbet
CHANDANA (SUMBA)
Grey cuscus
SERWATTY IS.
(Leti Is.)
(Sermata Is.)
Babber (Babar)
TIMOR LAUT (TANIMBAR IS.)
Dielli (Dili)
January to April 1861
TIMOR
Timor honeyeater
Coupang (Kupang)
December 1857
May 1859
100 fathoms
The 100-fathom line marks the extent of land bridge.
AUSTRALIA
0 mi 100
0 km 100
PRESENT-DAY PLACE-NAMES ARE IN PARENTHESES.

Multiple specimens of the golden birdwing butterfly, Ornithoptera croesus, *show the sort of subtle individual variations that provide the raw material for natural selection. Wallace collected more than a hundred specimens on an island called Batchian.*

NATURAL HISTORY MUSEUM, LONDON; FORT WAYNE CHILDREN'S ZOO (OPPOSITE)

Wallace called "flying" frogs "very interesting to Darwinians." They showed how webbed feet for swimming had been adapted for gliding.

years zigzagging among the islands, traveling by every sort of boat, from mail steamer to merchant schooner to dugout canoe. Onshore, he lived as the local people lived, sheltering in thatched houses and eating whatever could be traded for or bought. He made stops on Sumatra, Java, Bali, Lombock, Borneo, Celebes, Gilolo, Ternate, Batchian, Timor, Ceram, a little cluster of islands called Aru at the eastern extremity of the archipelago, and the Vogelkop peninsula of New Guinea. He sailed close past the island of Komodo (but despite his search for notable fauna, remained unaware of the existence of Komodo dragons). In some places, such as Sarawak and Aru, he lingered for months, netting butterflies and grabbing beetles in the nearby forests, shooting birds, or else simply processing his specimens and his impressions, healing his infected feet, recovering from bouts of malaria, waiting for the rains to end or the winds to shift. He learned enough of the Malay language to do business in remote locales. He hired a Bornean boy named Ali to help with bird shooting and other chores. Everywhere he went, he collected, preparing and packaging his insects and bird skins and mammal pelts with great care, keeping them with him until he reached a port, then shipping consignments to Samuel Stevens back in London. From little Aru alone, with its birds of paradise and other special attractions, he brought away more than 9,000 specimens, representing 1,600 different species, more than a few of those new to science. He figured the whole lot might be worth £500. Stevens sold it for twice that—amounting to about $100,000 in today's value.

The numbers from Aru, reflecting a ratio of specimens to species of almost six to one, signal a critical fact about Alfred Wallace and the way he worked. Being a commercial collector as well as a natural historian, he wanted multiple specimens of a given species, not just one or two representatives, especially if the species was visually impressive, such as the birdwing butterflies, the giant longicorn beetles, or the birds of paradise. In the Amazon he had taken 12 specimens of a spectacular flame red bird, the Guianan cock-of-the-rock *(Rupicola rupicola),* and admitted he would have killed 50 if they hadn't been so rare and elusive. In Aru, likewise, he was greedy for as many specimens of the greater bird of paradise *(Paradisaea apoda)* as possible. Still later, during an excursion along the Maros River in Celebes, he got six good specimens of *Papilio androcles,* one of the largest swallowtail butterflies, with long white tails dangling down like streamers. And from the island of Waigiou, just offshore from New Guinea's Vogelkop, he harvested 24 individuals of the red bird of paradise *(Paradisaea rubra).* His purpose in collecting multiples was not just to aggrandize supplies of the most decorative species for sale; it was also the desire to represent each species in his personal collection with a "good series" of individuals.

The consequence of such redundant collecting was that Wallace saw and recognized—to a degree that Charles Darwin had been slower to see and recognize—something momentous about creatures in the wild: That each species encompasses considerable variation among individuals. Not every specimen of *Papilio androcles* has tails as long and as white as every other. Not every greater bird of paradise is as great as every other. Individuals vary genetically from their siblings and cousins in ways that may manifest as visible and physiological inequities.

This insight is crucial to the idea of evolution by natural selection. Individual variation provides the differential material upon which selection works. Darwin appreciated such variation in domesticated species but became aware of its prevalence in the wild only during his long project on the classification of barnacles, an eight-year detour along his slow course toward publishing his theory. Wallace got there by a shorter route because, being forced to pay his way as a commercial collector, he constantly saw variation in his inventory.

PATTERNS OF SPECIES distribution in space and in time provided other clues toward an evolutionary theory. Those patterns told Wallace little about how evolution might work, but they reaffirmed his hypothesis (derived from the book *Vestiges*) that species had evolved, one from another, by some sort of natural process of descent and transformation.

Although he didn't use the word "biogeography," as early as 1852 he was practicing that branch of science. After returning from Brazil,

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David Quammen and Robert Clark previously collaborated on the award-winning November 2004 cover story "Was Darwin Wrong?"

he published a paper, "On the Monkeys of the Amazon," in which he described the distribution of monkey species in the upper Amazon Basin and showed that each was localized either on one side or another of the three great converging rivers, the main stem Amazon, the Negro, and the Madeira. This was curious. If God had created all species from scratch and placed them in their appropriate locations, why hadn't he put these monkeys on both sides of a given river?

Three years later in Borneo, as Wallace waited out the wet season in a lonely little house near the mouth of the Sarawak River, with no company but his Malay cook, he cast his mind back to some of the books he had read (such as Swainson's *Treatise on the Geography and Classification of Animals,* Humboldt's *Travels,* Darwin's *Journal*) and the museum catalogs he had inspected. Those sources offered plenty of raw data on the worldwide distribution of animals—which species and groups of species occur here but not there. Hummingbirds are native only to the Americas; sunbirds only to the Old World, from western Africa eastward. Toucans are a tropical American family; hornbills occupy roughly the same niches as toucans, but in tropical Africa, Asia, and the eastern islands. Similar patterns turn up among insects, fishes, reptiles, mammals, plants. Wallace hankered to know why. It occurred to him, he wrote later, "that these facts had never been properly utilized as indications of the way in which species had come into existence."

He also remembered, from reading Charles Lyell's three-volume opus on geology and the fossil record, how similar species seem to have succeeded one another in time. Combining these two forms of evidence, geographical and geological, Wallace formulated what he called a "law" of species origins: *"Every species has come into existence coincident both in space and time with a pre-existing closely allied species."* He composed a paper around that idea and sent it off to London. The paper's subtext, clear but unstated, was evolution—"closely allied" (similar) species appear adjacent to one another in geographical space and in geological time because they have descended from common ancestors. Wallace was now confident of that much. But he couldn't yet propose a mechanism by which such transformation occurred.

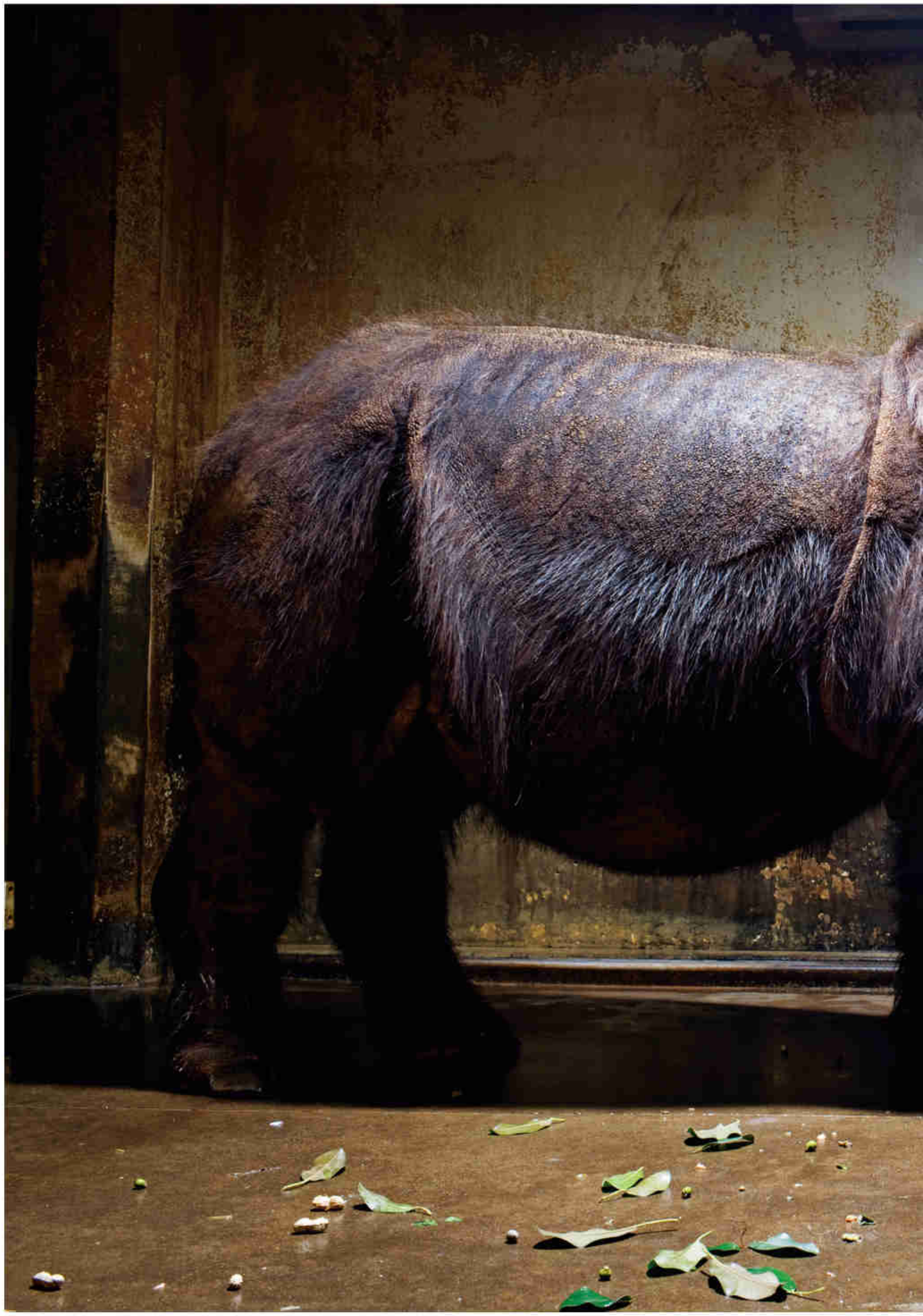
His paper was published promptly in a good natural history journal, but most of those who read it, including Darwin, failed to recognize that it represented the second big step by an obscure young naturalist toward a theory of evolutionary origins. Instead of positive feedback and intellectual engagement, for which Wallace had hoped, he got a message from Samuel Stevens about some naturalists who'd muttered that young Wallace should quit theorizing and stick to gathering facts.

He ignored that condescending advice. During stopovers on the islands of Bali and Lombock, which are separated by a deep but narrow strait, he noticed another set of presence-and-absence patterns. "In Bali we have barbets, fruit-thrushes, and woodpeckers," he later wrote. On the Lombock side "these are seen no more, but we have abundance of cockatoos, honeysuckers, and brush-turkeys, which are equally unknown in Bali, or any island further west." He would see similar disparities between the larger islands of Borneo and Celebes, just to the north, which faced each other across another deep strait. Borneo, on the west side, contained monkeys of many kinds, wild cats, *(Continued on page 132)*

Butterflies, beetles, and birds were mostly what was wanted, and if the creatures were both rare and gorgeous, all the better.

Birds of paradise, ornately adorned for mating displays, lured Wallace to the eastern reaches of the Malay Archipelago.

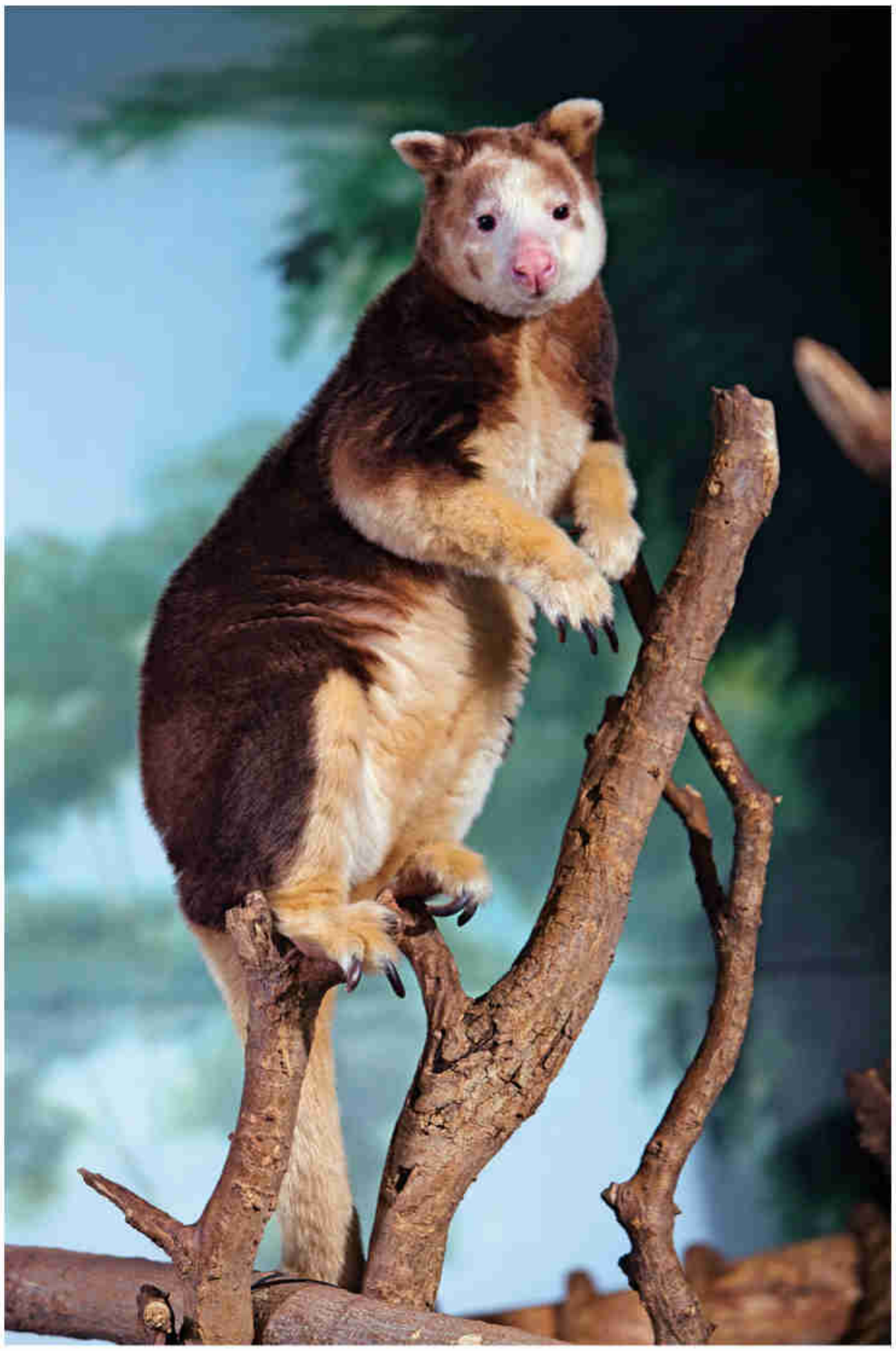
NATURAL HISTORY MUSEUM, TRING



Rhinos extended their range from Africa and mainland Asia as far east as Borneo when sea levels dropped. Of the Sumatran rhino (above), once also found in India and Southeast Asia, only about 300 survive in the wild. The Javan rhino is also endangered.

The siamang, a species of gibbon, is native to Sumatra and parts of the Asian mainland. More than a dozen gibbon species occur west of Wallace's line; east of it, none.

THE WALLACE LINE



In New Guinea and northeastern Australia, tree kangaroos have adapted to fill niches occupied elsewhere by primates. Wallace recognized that evolution works with what's available.

SAINT LOUIS ZOO; FORT WAYNE CHILDREN'S ZOO (OPPOSITE)

In Bali, Wallace found Asian-African bird groups such as barbets, bulbuls, and woodpeckers. These barbet specimens bear his original labels.

NATURAL HISTORY MUSEUM, TRING; SANTA BARBARA ZOO (OPPOSITE)

Having crossed to Lombock, he saw cockatoos such as this yellow-crested species. The strait between Bali and Lombock, always a deep-water barrier, has constrained some bird species.

Unsentimental, Wallace collected even orangutans. He tried to raise a young orphan, but when it died, he skinned it. One of his specimens stands today in a storage facility of London's Natural History Museum, as though contemplating its own mortality.

NATURAL HISTORY MUSEUM, WANDSWORTH

(Continued from page 123) deer, civets, otters, and a high diversity of squirrels. Celebes, on the east side, harbored few native mammals, one being the marsupial cuscus, whose "allied" species (other cuscuses, and marsupials generally) could be found eastward, through the Moluccas, New Guinea, and Australia. All these facts fit an evolutionary vision of biogeography more persuasively than they fit a pious dogma of special creations.

The third step toward his theory was the one he took in 1858, somewhere on or near Ternate, when he suddenly put the clues from biogeography together with the phenomenon of variation within species, the insights of Malthus on excess population growth, the fact that food and habitat are limited even when reproductive rate isn't, and the realization that most offspring born to any species cannot survive. "Vaguely thinking over the enormous and constant destruction which this implied, it occurred to me to ask the question, Why do some die and some live?" His answer was that those variants best fitted to their circumstances survive. "An antelope with shorter or weaker legs must necessarily suffer more from the attacks of the feline carnivora," as he put it. Furthermore, this process must yield adaptive directional change in the species overall. Why does a giraffe have a long neck? Because the short-necked ones have failed to leave offspring.

Excitedly, he sent off his manuscript to Mr. Darwin, whom he knew as a genial but somewhat aloof scientific pen pal. In the cover letter Wallace said that he hoped the idea would be as new to Darwin as it was to him.

Of course it wasn't. To Darwin the idea was 20 years old, and it was his. But after two decades of continuing research, refinement of his arguments, distraction into other projects, and hesitancy, Darwin had nothing in print to prove ownership.

ALFRED WALLACE was stuck on the coast of New Guinea, punished by wet weather and hunger and fever, on the July evening when Wallace's paper, along with unpublished offerings from Darwin, were read as a joint presentation to the Linnean Society. That event, a delicate and somewhat high-handed compromise allowing Darwin the opportunity to co-announce the discovery with Wallace, had been brokered by two of Darwin's powerful scientific friends. Wallace himself had not been consulted about the arrangement, although he was pleased and flattered when he heard of it. In November of the following year, 1859, Wallace was still in the Malay Archipelago, still chasing new butterfly species and enduring physical hardships, when Charles Darwin published *On the Origin of Species,* the book he had composed hastily after being shocked into action by Wallace's paper. Wallace received his copy by mail steamer, as a courtesy from Darwin, and read it five or six times, each time more impressed with how Darwin had brought the whole subject together. "It is the 'Principia' of Natural History," he wrote to an old friend. "Mr. Darwin has given the world a *new science* & his name should in my opinion stand above that of every philosopher of ancient or modern times. The force of admiration can no further go!!!" If Darwin's name stood above that of every philosopher, it would certainly stand above Wallace's as author of this evolutionary theory. And so it did. But Wallace, a generous-spirited man, comfortable with his own strengths and limits, didn't begrudge that.

About the same time, he sent another paper back to London, to be published in the Linnean Society journal as "On the Zoological Geography of the Malay Archipelago." Here he enlarged upon his observations of animal distribution to recognize two distinct biogeographical regions, the Indian and the Australian. Draw a line through the strait between Borneo and Celebes, continue it southward between Bali and Lombock, and to the west of that line you would find primates, carnivores (including the tiger, right into Bali but no farther), insectivores, pheasants, trogons, bulbuls, and other distinctly Asian species; to the east you would see cockatoos, lories, cassowaries, megapodes, cuscuses and other marsupials, and a much higher diversity of parrots than squirrels. The two regions, though their climatic and habitat conditions are similar, harbor two distinct complements of fauna. "Facts such as these can only be explained by a bold acceptance of vast changes in the surface of the earth," Wallace wrote. What he meant was this: The whims of God didn't put species where we find them. History, evolution, ecological dispersal, and geological changes did.

Eight years later the brilliant anatomist and Darwinian partisan Thomas H. Huxley called

this east-west boundary "Wallace's line," and the label endured.

Although Wallace correctly deduced that Bali and Borneo had formerly been part of the Asian mainland, he didn't know that lowered sea levels (during glacial periods) had caused the intermittent connectedness; nor could he imagine that Celebes was an anomalous island patched together by plate tectonics. Still, he anticipated those insights with his pointed presentation of evidence he had gathered during his years of looking and collecting. Wallace's line, dividing the Southeast Asian region from the Australian, became one of the fundamental facts of modern biogeography. In itself it was merely a descriptive delineation; what made it profound and useful were the evolutionary, ecological, and geological questions that it brought into focus. Alfred Wegener, proposing continental-drift theory in the early 20th century, would be another scientist among many indebted to Alfred Russel Wallace.

WALLACE RETURNED to England in 1862, by which time *On the Origin of Species* was in its third edition and Charles Darwin well on his way toward being renowned and excoriated throughout the world. Wallace reached London bearing two live birds of paradise, which he sold to the Zoological Gardens. Darwin welcomed him as a valued colleague and invited him for a home visit almost as soon as Wallace stepped off the boat. During his Malay expedition, Wallace figured, he had traveled 14,000 miles within the archipelago (not counting the distance between London and Singapore), made 60 or 70 separate journeys, and collected 125,660 specimens. Thanks to Samuel Stevens, he had some money awaiting him.

But life afterward wasn't easy for Wallace. He lost a sizable share of his capital by unwise investments, and he helped support other family members, including his mother. He tried for a couple of tempting jobs (museum administration, forest management), didn't get either, and couldn't afford to stop scrambling for money. So he kept himself busy as a freelance author of articles and books, which gave him great mental freedom but zero security. By early 1869 he had a wife and two children. Also that year, he published *The Malay Archipelago,* the great narrative of his travels through the eastern islands. In 1880, when Wallace was struggling financially, Darwin stood up for his old partner in discovery, lobbying hard and successfully to get him a special government pension.

Wallace's later career and the diverse vectors of his thinking are best represented by his publications. Among his books were *Contributions to the Theory of Natural Selection* (1870), *On Miracles and Modern Spiritualism* (1875), *The Geographical Distribution of Animals* (1876), *Tropical Nature, and Other Essays* (1878), *Island Life* (1880), *Land Nationalisation* (1882), *Bad Times: an Essay on the Present Depression of Trade* (1885), *Is Mars Habitable?* (1907), and *The Revolt of Democracy* (1913). When he published a full treatise on natural selection, in 1889, with characteristic humility he titled it *Darwinism.* Eponymy wasn't important to him; ideas were; and he remained extraordinarily free of concern about who got credit for what.

He had lived richly for a man without much education or money. He had traveled far and widely, both in geographical space and in intellectual breadth. He knew his own line. There was none other like it. □

"It occurred to me to ask this question, Why do some die and some live?" Wallace's answer was that those variants best fitted to their circumstances survive.

Wallace found, among all else, the world's largest bee. The inch-and-a-half-long females have huge jaws for collecting resin.

NATURAL HISTORY MUSEUM, LONDON

Ron Reed hoists a chinook salmon into fellow Karuk Tribe member Johnny Garrison's waiting hands. Ishi Pishi Falls is the last place on the Klamath River, which straddles the Oregon-California line, where Karuk still use dip nets. Salmon have been sparse in recent years: The tribe harvests only about 400 fish a year here.

REUNITING A RIVER

After fighting for years over its water, farmers,
Indians, and fishermen are joining forces to let
the troubled Klamath River run wild again.

Copco No. 1 Dam is one of several Klamath dams in Oregon and California that together provide clean power for up to 70,000 homes. But dams block salmon runs and may degrade river water quality. Conservationists and Indian tribes want to raze four of them—an unprecedented removal project.

BY RUSS RYMER
PHOTOGRAPHS BY DAVID McLAIN

Silver shapes glinted up at Thomas Willson out of the river depths, shining like spilled coins through the surface rills. Before his square-nose aluminum skiff even reached the sandbar, Willson could tell it wouldn't be the worst of mornings, one of those days when he came up with nothing but a soiled net and went home empty-handed. But when he leaned over the gunwales and hauled the gill net up out of the strangely warm Klamath River water, what he found didn't please him:

a large chinook salmon that should have been the day's prize, except that its flanks were dull and pocked with whitish sores. When Willson ran his fingers under its gill scutes, the tissue floated out in a viscid pinkish soup. "Never used to see this," Willson grumbled, and with a discus thrower's shoulder spin he heaved the blighted carcass onto the riverbank. Above him a buzzard floated in the river canyon's narrow slice of California sky. It would soon get its commission.

Willson's expression fell on the sorrow side of anger. Fishing was more than a pastime for him and more than a vocation; it was a patrimony. In the annals of father-to-son enterprises, the Willson family franchise surely ranks among the venerable: Thomas Willson and his ancestors have been fishing this very species in this very stretch of this very stream without interruption since Yurok Indians first made their home on the Klamath River and fed themselves on its salmon. Indian tribes have resided alongside the Klamath for more than 300 generations.

In all that time, the river had never suffered the troubles of its recent years. The signs were everywhere: in the tresses of algae clinging to every twist and tie of his net; in the warmth of the mountain river water, which would reach 74°F before midmorning; in the smoke floating overhead from forest fires that no longer burned themselves out. And in the paucity and poor condition of the fish. The underlying source of the problems, Willson knew, was a resource crisis of growing magnitude in the western United States and globally: too many users for not enough water. Looking around him on this not worst of mornings, Willson had the feeling there wasn't much about his little patch

of Earth that wasn't out of balance. The Klamath River was in trouble, and Willson was certain where the trouble came from: upstream.

In a holding pattern, spring chinook salmon congregate in the depths of a pool on the Salmon River. In early fall, they'll head farther up the Klamath tributary to spawn. Spring runs of chinook salmon in the Klamath numbered as high as 800,000 in the early 20th century but have fallen dramatically in recent years.

TWO HUNDRED AND FIFTY MILES upstream, at two in the morning, the alarm blared on the humidity meter on the Formica snack table in Steve Kandra's RV, and Kandra slid out of his berth and into his boots and climbed aboard the John Deere tractor awaiting him in his pitch-dark alfalfa field, a field irrigated by the same Klamath waters that Thomas Willson fishes. Kandra had mowed the alfalfa several days before; tonight he would bale it while the cut crop was safe from the parching daytime heat and before the morning

dew turned everything too wet. Farming by ideal conditions meant living on the wrong side of adage: Kandra makes hay till the sun shines.

As drought years have become more problematic in the Klamath region, the competing water needs for Thomas Willson's fish and for Steve Kandra's fields have aggravated the rivalry between the Indian tribes living near the northern California coast and the irrigating farmers upstream along Oregon's arid southern border. The trouble, as farmers see it, came to a boiling point in 1997. That's the year coho salmon were accorded federal protection under the Endangered Species Act, which would entitle them to minimum flows of water. In 2001 tensions came to a dramatic head when the federal government shut off irrigation water to some 1,400 Klamath Reclamation Project farmers, including Kandra. The families felt singled out—"Farmers aren't used to being vilified," Kandra notes—and some responded with civil disobedience. They partially opened the irrigation canals' headgates in defiance of federal marshals and queued up for a symbolic bucket brigade through the streets of Klamath Falls, Oregon.

That summer the upper basin was a dry Dust Bowl flashback to *The Grapes of Wrath*. But by the following spring, reportedly thanks to Vice President Dick Cheney's behind-the-scenes intervention, the situation had reversed. In March 2002, Agriculture Secretary Ann Veneman and Secretary of the Interior Gale Norton flew to Klamath Falls to open the valve into the main diversion canal and assure farmers they would have the water they needed. Matter settled.

Then came the sequel.

As Thomas Willson recounts, in September 2002, a vanguard of the fall salmon migration passed the coastal sandbar at Requa, California, and entered the mouth of the Klamath. The fish swam as far upstream as Blue Creek, a popular deep-pool gathering ground for their run up the river. Then, perhaps because the water in the slack river was so warm, they retreated back to the estuary. Rain in the Siskiyou Mountains cooled the river enough to encourage the fish to head back upstream, but when the weather turned sunny and hot, the fish, wearied by the false start and weakened by infections, didn't get far: At least 30,000 chinook salmon died in the lower 40 miles. Their carcasses carpeted the Klamath's banks in one of the largest adult fish die-offs in U.S. history.

The root causes of the massive fish kill remain disputed—there had been warmer temperatures and lower water levels, without disaster—but it certainly seemed to fulfill the dire prophesy of those who had opposed the opening of the

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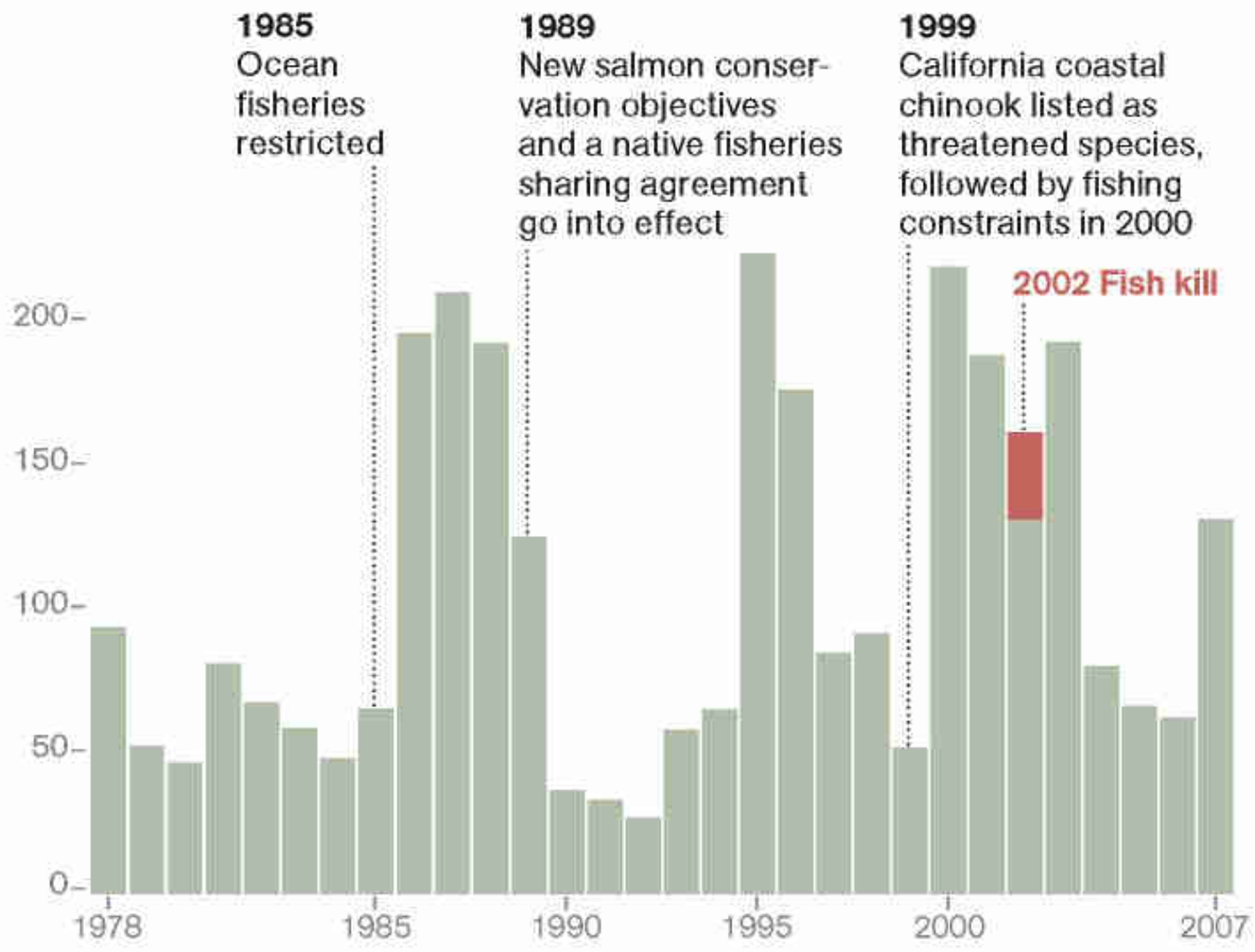
Russ Rymer is the author of Genie: A Scientific Tragedy *and* American Beach. *David McLain's last photographs for the magazine were about allergies.*

Adult Chinook Entering the Klamath River Each Fall

1978–2007, in thousands of fish



The Klamath's chinook salmon population is sharply reduced from historic highs. But today, the population varies dramatically year to year, reacting to an interplay of ocean conditions, the state of the river, and fishery management. Pacific Ocean conditions in the early 1990s led to several years of low counts. Poor water quality in the river could have led to the combination of infectious diseases, including *Ichthyophthirius multifiliis,* that resulted in a die-off of 30,500 adult chinook salmon in 2002.

MARTIN GAMACHE, NG STAFF (BOTH)
SOURCE: CHUCK TRACY, PACIFIC FISHERY MANAGEMENT COUNCIL

floodgates and the constriction of river flows. Indian tribes and farmers and commercial ocean fishermen (who can have their seasons curtailed when salmon are scarce) confronted each other over flow rates and toxic algae, environmentalists insisted that farmers be evicted from leased land on Klamath wildlife refuges, and almost everyone squared off against Pacific Power, the company that owned the hydroelectric dams controlling the flow of the water. An epic American free-for-all erupted.

IN THE ANNALS of father-to-son enterprises, the three-generation Kandra franchise may not boast the longevity of Willson & Co., but it can still be expressed in epic terms: Kandras have cultivated Klamath land ever since it *became* land. The two stretches of open field and farmyard homesteaded by Steve Kandra's grandfather and father look as solid as slab granite, but they bear liquid names: Lower Klamath Lake to the west, and Tule Lake to the east. A little over a century ago, they were just that: expansive lakes.

Beginning in the early 1900s, in a mammoth engineering endeavor christened the Klamath Reclamation Project, much of the lake water was drained by the U.S. Reclamation Service to create new farms, more than 100,000 acres of them, and the new land was irrigated to make it arable. Hundreds of miles of canals and tunnels were built, and massive pumps installed to

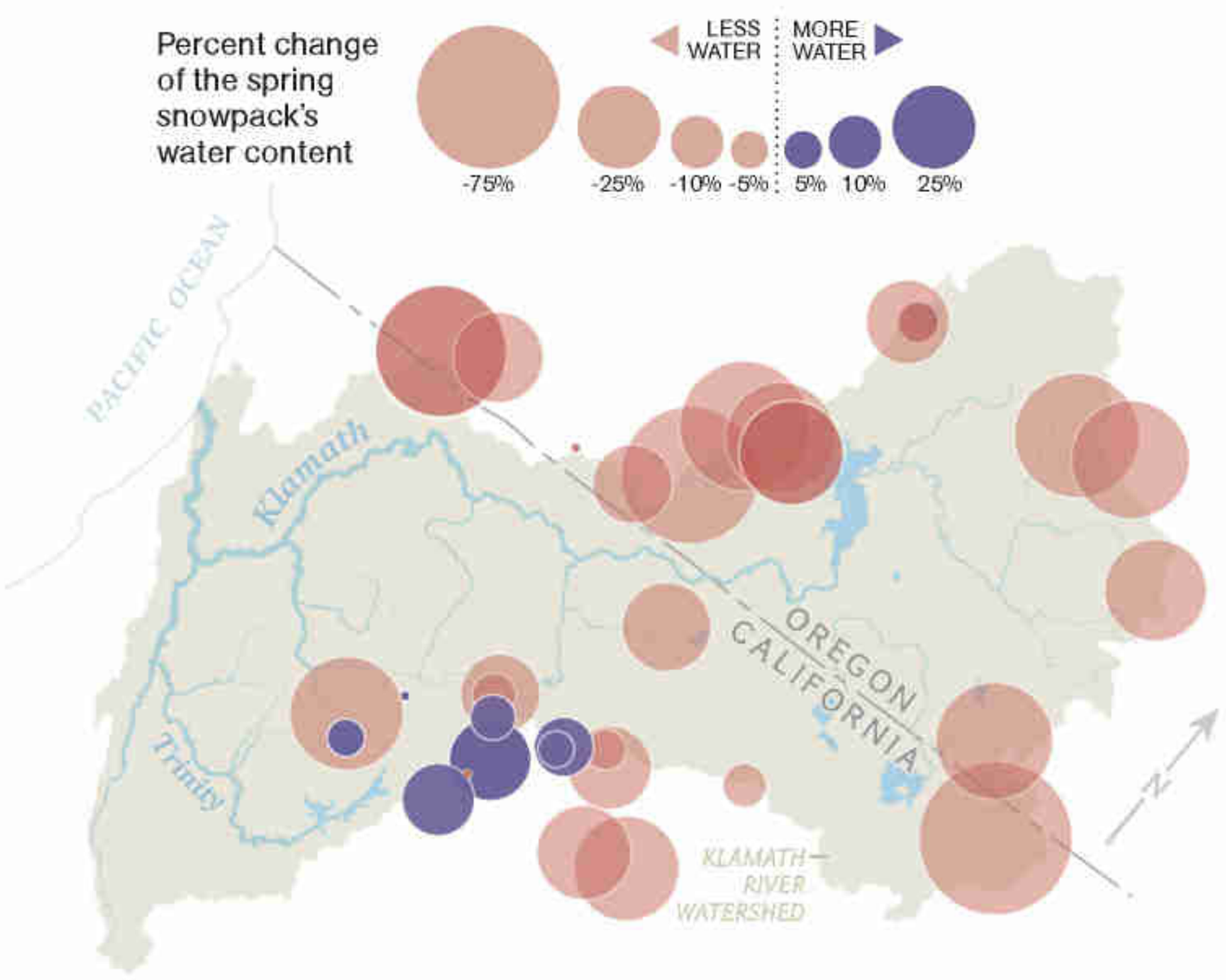
The carcasses of 30,000 salmon carpeted the lower 40 miles of the Klamath River's banks in one of the largest fish die-offs in U.S. history.

sluice water in and out. The "reclaimed" land in Tule Lake Basin was homesteaded, much of it by returning veterans of both World Wars whose names were drawn from a pickle jar; the farmers planted alfalfa, grain, potatoes, and onions on some of the most fertile soil in the West. Fertile because, as Kandra noted, shouting over the roar of his baler as he traced windrows of alfalfa in the headlights of his John Deere, "down below us is a thousand feet of goose poop. It's old lake bottom. We're farming the top of a custard—you know how custard has a skin on it? We're on top of the skin."

The partition of the Klamath River was made concrete in 1918, when the California Oregon Power Co. (long known as Copco; later bought by Pacific Power) built the first of its big hydroelectric dams on the Klamath. Three other major dams followed, the farthest downstream being Iron Gate Dam, finished in 1962. Today the dams are the backbone of the power system that produces 750,000 megawatt hours for

Spring Snowpack Trends in the Klamath River Watershed

1945–2002, at 32 monitoring stations



Mountain snowmelt delivers most of the water vital to fish and farms along the Klamath River. But since the mid-20th century, spring snowpack has declined significantly, with serious consequences. The situation is worst at lower elevations, where warming regional temperatures are reducing the territory where snowpack can build up and persist late into the season. Scientists measure snowpack water content to estimate water availability during the spring and summer, when fish are on the move and irrigation demand peaks.

SOURCE: PHILIP MOTE, CLIMATE IMPACTS GROUP, UNIVERSITY OF WASHINGTON

A RIVER UPSIDE DOWN

Instead of beginning like many rivers in remote mountains and flowing to an outlet on a heavily populated coast, the Klamath River starts in a well-peopled agricultural region where it's heavily tapped for irrigation. The 250-mile-long river arcs across a ten-million-acre-plus basin, flowing through hydroelectric dams in its upper and middle stretches before reaching wilder territory approaching the Pacific Ocean.

PACIFIC OCEAN
Crescent City
YUROK INDIAN RESERVATION
REDWOOD NATIONAL AND STATE PARKS
Requa
Klamath
Blue Creek
Klamath River
Pecwan
Ishi Pishi Falls
Somes Bar
Weitchpec
HOOPA VALLEY INDIAN RESERVATION
Hoopa
Trinity
Arcata
Willow Creek
South Fork Trinity
New
N. Fork Trinity
Canyon Cr.
Stuart Fk.
Lewiston Lake
Weaverville
Hayfork
Trinity
Salmon
Forks of Salmon
North Fork
South Fork
Trinity Alps
Coffee Creek
Trinity Lake
Trinity Center
TRINITY DAM
LEWISTON DAM
CLEAR CR. DIVERSION TUNNEL
Black Rock Mountain 7,792 ft 2,375 m
Redding
Trinity Mountains
Marble Mountains
Salmon Mts.
KLAMATH MTNS
SISKIYOU MTNS
OREGON
CALIFORNIA
Happy Camp
Seiad Valley
Condrey Mountain 7,112 ft 2,168 m
Scott
Etna
Fort Jones
Yreka
Montague
5
Shasta
Lake Shastina
Weed
97
Mt. Shasta
Mount Shasta 14,162 ft 4,317 m

California Diversions
One of the Klamath's chief tributaries, the Trinity River is an important contributor to flow in the lower portion of the Klamath. Yet up to 90 percent of the Trinity's water is diverted at times to California for irrigation and navigation.

Undamming the Klamath
The 2008 Klamath Basin Restoration Agreement proposes removal of four dams:

1. **Iron Gate Dam** built 1962
2. **Copco No. 2 Dam** built 1925
3. **Copco No. 1 Dam** built 1918
4. **J. C. Boyle Dam** built 1958

Flyways
Klamath River wetlands provide resting points for millions of migratory waterfowl negotiating the Pacific flyway.

Built-up area
Dense forest
Sparse forest
Irrigated land
Marsh/Swamp
Pasture/Grassland

0 mi 20
0 km 20

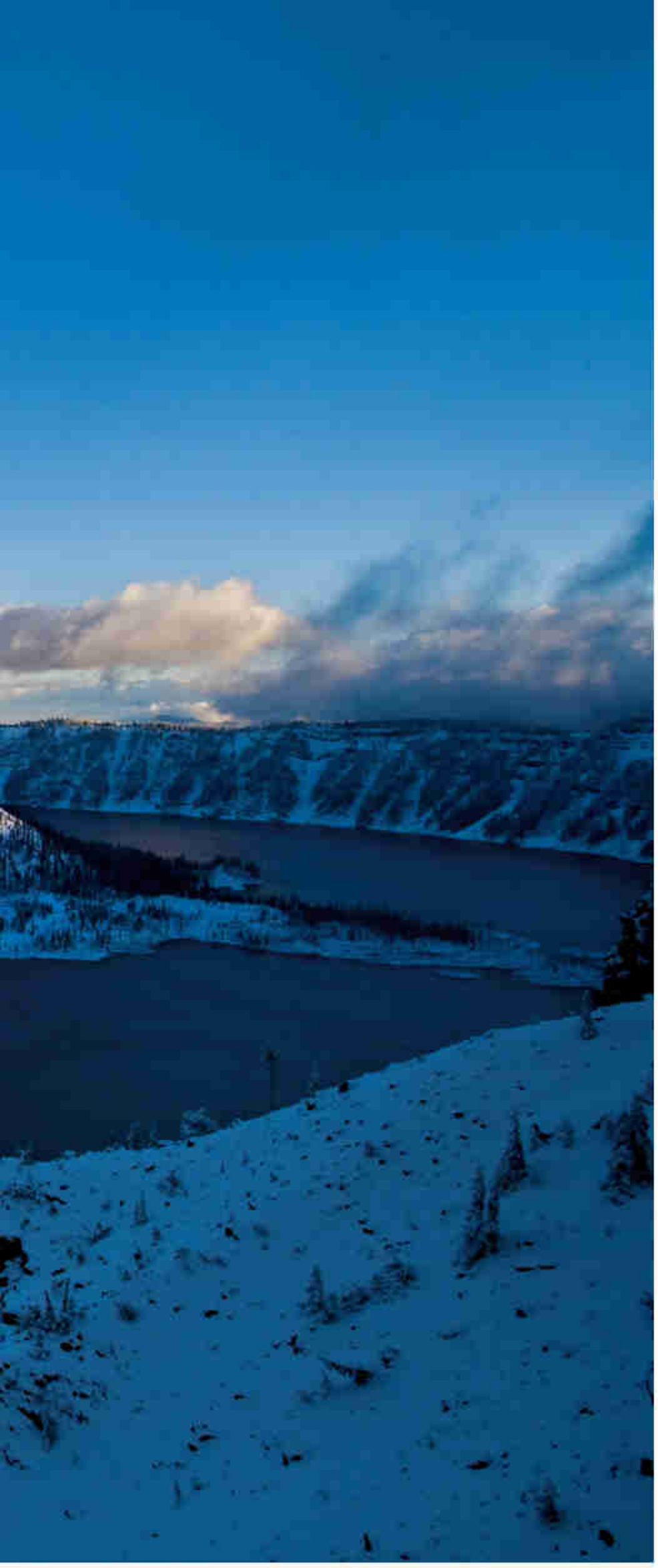
ALLAN CARTOGRAPHY: NGM MAPS

SOURCES: BUREAU OF INDIAN AFFAIRS; NATIONAL LAND COVER DATABASE 2001; USGS

Crater Lake's 1,943-foot depths were created following volcanic eruptions 7,700 years ago; a lava outcrop juts from the northwest rim of the caldera. Snowmelt from the surrounding Cascade Mountains percolates through the land to the south, emerging as springs that feed streams flowing into Upper Klamath Lake.

Pacific Power in an average year, enough to meet the electricity needs of 70,000 homes. It's especially useful power in that it releases no carbon emissions and can be turned on in an instant to supply peak needs.

The dams have long been a focus of local pride for the upriver communities, emblems of autonomy for a region that had always held itself self-consciously apart. Residents call this stretch of far northern California and far southern Oregon the "State of Jefferson," and have on occasion discussed separating from their respective states and incorporating as a new state. Various efforts at statehood have faltered over the years, but Jefferson lives on as a code name for pugnacious



patriotism. From the start, the local utility was a part of this independence. "I've heard that when they held an essay contest for the name of the new state they were going to form, the name that was suggested second to 'Jefferson' was 'Copcoland,'" says Toby Freeman, regional community manager with Pacific Power.

Whatever their utilitarian purpose, the dams effectively divided the river into two peoples, one of which lived off salmon, and the other of which never even saw one, since the dams obstructed the fish's upstream migrations. For the dams' opponents, the physical obstacle is only one of the ways the dams upset the Klamath's balance. Fishermen contend that the water

Winters are bringing less and less snow to the American West, and snowpack is mother's milk to western rivers like the Klamath.

impoundment alters the temperature and flow of river waters, encouraging fish diseases. In 2008, the Karuk Tribe released a report concluding that the cyanobacteria, commonly called blue-green algae, that bloom dramatically in the still summer waters behind Iron Gate are releasing toxins that could make fish and freshwater mussels unsafe to eat.

The issues in play over the Klamath's future are complex, but one prospect resides at the center of all the debate: removing the four hydroelectric dams. Advocates hope this might restore the river to its natural condition and allow migrating salmon an unobstructed path to headwater breeding grounds for the first time in a century. Demolition of the dams would also remove a symbolic barrier between the upriver and downriver human communities, but those parties haven't waited for dynamite to facilitate their convergence. For the past eight years, a group of affected parties—governmental, tribal, industrial, and private—has been convening over an endless series of conference tables in drab offices and motel meeting rooms, working its way through a cat's cradle of interlocking questions. If the talks succeed in resolving the Klamath conflict, the result will be historic. And if the dams are removed, notes Craig Tucker, Klamath Campaign coordinator for the Karuk Tribe, "this will be the largest dam removal ever on an American river. This can be a model for environmental cooperation."

Just in time, some might say. The perils to the nation's rivers are growing dramatically, as population growth and rising water usage overtax watersheds and deplete aquifers. In the western United States, that skyrocketing demand is on a crash course with the alarming effects of climate change. In response to warming temperatures, winters are bringing less and less snow to the American West, and snowpack is mother's milk to rivers like the Klamath. The Cascades and other Northwest mountains whose

snowmelt feeds the river are the harbingers of what's to come elsewhere. Since the 1940s they have seen a significant decline in total snow accumulation because they are lower in elevation and so more susceptible to the region's rising temperatures than other western mountains. All of which makes the decisions over how to handle the competing needs for the Klamath's waters even more crucial. In coming decades, as governmental agencies turn increased attention to rescuing the world's riverine ecologies, they may cast an eye back to the way the small and relatively isolated communities of the Klamath River watershed negotiated their entrenched local issues and resolved historic antagonisms.

Especially since until this year, those issues seemed so intractable, and the antagonisms so fierce. Toby Freeman of Pacific Power, the company that would be responsible for the dams' removal, understands those antagonisms as well as anyone. Last year, asked for his forecast on the outcome of the river negotiations, he responded with bureaucratic cheer. "In the long run, I'm looking forward to a resolution that fully addresses the river's health while providing the best outcome for our customers," he said.

"In the short run," he added, "I'll be happy if no one gets shot."

PERHAPS IT'S APPROPRIATE that the sources of the Klamath River begin in a geographic region known informally as the "blast zone." The blast in question was the eruption 7,700 years ago of Mount Mazama, one of the restive volcanic cones of the High Cascades, in southernmost Oregon. Klamath Indians explained the explosion as a battle between the sky god Skell and Llao, the deity of the underworld. Geologists describe it more technically. A series of eruptions blew much of Mazama's molten understory skyward; a mile-wide column of pumice, ash, and gas climbed into the upper stratosphere. As the 12 cubic miles of mountain and mantle fell back earthward, it draped 320 million acres in tephra—volcanic ash and rock—in a layer as thick as 20 feet. The remaining bulk of Mazama's summit collapsed (the mountain lost about a mile of elevation during the eruption), and the caldera filled partially with water, creating the consummate natural tourist attraction, Crater

Behind the Klamath's oldest dam, a biologist samples soupy water (left) thickened by cyanobacteria in the Copco Lake. The toxic microorganism blooms when water heats up in summer. Some 30 miles east, irrigation channels outline fertile polygons on the drained bed of Lower Klamath Lake (above).

Lake. To the lee of the crater stretched a vast new living desert of pumice, and, with time, a broad-based forest ecosystem dominated by bitterbrush, aspen, and lodgepole pine. Crater Lake locals liken a stroll through the blast zone to walking in kitty litter. The pale granular topsoil crunches underfoot and emits effusions of smoke-fine dust.

Coursing through the kitty-litter landscape are the tannin-stained streams that make up the headwaters of the Klamath River. They are fed by snowmelt from the Cascades, but much of that melt doesn't run downhill as surface water. Instead it soaks deep into the absorbent tephra and bubbles up as springs to feed the Williamson and Sprague Rivers, which run into Upper Klamath Lake. The water flows from there into Lake Ewauna, the official beginning of the Klamath River, which then flows into the Cascades and along the rugged Siskiyous. Its progress looks decidedly odd to anyone who's ever seen a…well, to anyone who's seen a river.

"It's a river upside down," Steve Pedery explained one summer afternoon, echoing a phrase often used to describe the Klamath. Pedery was speaking over the propeller roar of a Cessna. He is conservation director of Oregon Wild, an environmental organization, and the plane was courtesy of LightHawk, a group that provides overflights of ecological battlegrounds. "You know," Pedery said, as the lakes below us dwindled into a thin tinsel ribbon, "most rivers begin in the mountains, flow into farmland, and end up in a heavily industrialized urban port. The Klamath starts in farmland and flows through mountains that become wilder the closer you get to the coast."

The river is upended in another way. Most rivers begin pristine and wind up filthy. The Klamath gets "dirty" at its outset and becomes cleaner as it goes along. Even without the

The Klamath winds through Oregon farmland, where Lincoln Gabriel rides out with his dogs to maintain irrigation ditches on 220 acres. Born in 1927, Gabriel has raised crops and run cattle here since his teens. “We ranchers paid for these ditches over 50 years,” he says. “The government said we’d have the water we need.”

Streams mix at the confluence of the Klamath and Salmon (at left) Rivers. More than a hundred miles downstream from the nearest dam—Iron Gate—the spot is more than just scenery to the Karuk Indians, who hold the Jump Dance, one of the High Dances of the World Renewal religion, on the riverbanks.

In the clear waters of the Salmon River, friends struggle for a grip on a greased watermelon during a party thrown by the Mid Klamath Watershed Council to celebrate watershed restoration and salmon conservation work.

significant agricultural pollution feeding the profuse blue-green algae that skews the ecology on the upper Klamath, the river would have high levels of nutrients such as phosphorus, derived from the lake-bed soils of Upper Klamath Lake. Similarly, the warmth of the water may be exacerbated by dam impoundment and basking in farmers' fields, but the river was always naturally warmed by wide shallow lakes at its source. Only as the Klamath is joined along its descent by more traditional tributaries, the Trinity and the Scott and the Salmon, does it clean up and, at least temporarily, cool down.

The Klamath's upside-down design means it is exceptionally well poised to benefit from restoration. It has little of the industry and suburban development that clutter the shores of most American rivers. Most of its last 40 miles can only be visited by boat; no through road follows the river's course, and remote tribal villages like Pecwan, where Thomas Willson launches his fishing boat, are beyond the reach of electricity. If the dams are remade or removed, many experts agree that the Klamath could bounce back and become perhaps the healthiest big salmon river in the West. Maybe just as remarkable, saving the river could put an end to an unlovely slugfest among parties that historically, at least in the case of farmers (read pioneers) and Indians (read Indians), had been drawing each other's blood for a century and a half.

THE INDIANS OF THE KLAMATH RIVER watershed were among the very last Native Americans to be overrun by Manifest Destiny. A handful of tribes called the region home: the Modoc, Klamath, and Shasta Indians in the upper and middle basin, and the Karuk, Hoopa, and Yurok in the lower. The human onslaught that overtook them began in the mid-1800s; it would bring successive waves of settlers, gold miners, soldiers, loggers, farmers, and commercial fish canners. When the extraction of gold in the

river's tributaries sent slurries of mud and tailings downstream, the native peoples got their first exposure to industrial pollution, and to the notion that an economy could be enriched by destroying its resources, instead of husbanding them. The Klamath River tribes were traders, and their currency, dentalium shells that tribespeople carried in oblong elk-horn purses, was valuable in relation to its scarcity. The shells were acquired from other tribes far to the north; unlike gold, they required no desecration to accumulate.

One hundred years after the gold rush, the lower Klamath welcomed an unusual visitor: Erik Erikson, the psychoanalyst who popularized the notion of the identity crisis. He'd come to study the Yurok Indian Tribe, whose worldview he described as "centripetal." Erikson meant that Yurok society was inwardly focused, a closed bell jar of a universe into which salmon and deer entered to sustain the tribe, but which the tribe's members never left. Their compass points were "away from the river" and "toward the river," as though the Klamath exerted an irresistible magnetic force that attracted much but let little go. The lower Klamath tribes share a religion known as World Renewal, which exalts nature's interconnectedness but sees that balance as precarious.

Leaf Hillman is vice chairman of the Karuk Tribe and a World Renewal priest whose family oversees a White Deer Dance, one of the rituals through which cosmic equilibrium is maintained. "This is a pretty unique place in the world," Hillman told me one day, kneeling by the entrance of a traditional sweathouse, a ten-foot-by-ten-foot-square structure topped with a gabled, wood-plank roof. The Klamath's currents burbled only yards away. When he was 13, Hillman was inducted into the Karuk priesthood and underwent a week of fasting and purification, sleeping by the fire in the sweat lodge and setting out each morning, dressed in deerskin and painted by an elder priest, on quests into the wild, learning the scripture of humanity's relationship with nature. Humans have a responsibility to all other elements of nature, Hillman told me. "It's a reciprocal arrangement. We understand, and we know, that we owe our existence to the river."

The river was transportation and it was also sustenance, providing the willows used to make baskets and bringing the salmon and lamprey

If the dams are remade or removed, the Klamath could bounce back and become perhaps the healthiest big salmon river in the West.

and trout that complemented acorns in the native diet. Back then, as the elders remember it, the fish were so thick that a person "could walk across the river on their backs," and salmon filled every belly. Traditionally, Karuk Tribe members each ate more than a pound of salmon a day, an intake that has dwindled in recent decades to under five pounds a year, with a commensurate surge in diabetes and heart disease.

With the disruption of the Indians' livelihood, and the river's inhabitants divided into mutually antagonistic communities, the Klamath faced the conundrum that stymies environmental efforts everywhere: Its problems were vast and expanding, but the communities that might solve them were too fragmented to mount a holistic response. Ironically, the historic bone of contention, the old Copco dams and what should happen to them, became the agent that would bring the warring parties together.

FOUR YEARS AFTER the massive salmon kill of 2002, the licenses for all four mid-Klamath dams came up for their 50-year renewal by the Federal Energy Regulatory Commission. In anticipation, Pacificorp, the parent company of Pacific Power, had begun meetings in 2000 with the Klamath area tribes, municipal governments, commercial fishermen, farmers, and environmental groups. The issues were daunting: What could replace the dams in providing Siskiyou County's tax base? If the dam removal succeeded in restoring salmon to the upper Klamath, what would happen if a farmer found an endangered coho in his irrigation canal; would he be shut down under the Endangered Species Act? Oregon Wild pushed hard to have farmers evicted from leased land on wildlife refuges; the Hoopa Valley Indian Tribe insisted that scientific studies be commissioned to verify that water-flow allotments would support the salmon. In 2006, after years of debate, and with talks expanding beyond dam removal

A Native American boy snuggles up to a brace of chinook salmon his family caught in Requa, California. Diverse communities depend on the river for sustenance—and often their needs clash. "We've all got to let go of hard feelings," farmer Scott Seus says, "and try to find a common way ahead."

and into such issues as tribal rights and river restoration, the group disbanded.

And then it reconvened, without Pacific Power involved, and with some of the more intransigent parties disinvited. Ron Cole, refuge manager for the Klamath Basin National Wildlife Refuges and, like Craig Tucker and Steve Kandra, a party to the talks, observed the turnaround. "The folks in this basin have never missed an opportunity to miss an opportunity, but I think they're tired of it," he told me. "This is considered ground zero for screwing up. But it can also be ground zero for success."

Last January the settlement parties announced the Klamath Basin Restoration Agreement,

outlining options for saving the river. But negotiations with PacifiCorp over removal of the dams—a key part of the plan—continue to drag on. Some entities, including the Hoopa tribe, remain unconvinced that their concerns have been addressed. And congressional action will be necessary to defray economic damages—implementing the agreement would cost hundreds of millions, perhaps billions, of dollars. Still, the most promising indication for success, and for the future of the Klamath, may have already taken place: the transformations within the individual river communities. The farmers took to heart their own observation of the Klamath's failing ecology. "People see that our farm inputs—oil, water, fertilizer—aren't infinite, like they seemed to be 20 years ago," Klamath farmer John Anderson said. The Andersons responded by shifting crops and refining their irrigation methods. Other farmers, like the Kandras, installed new pivot irrigators that are stingier with water than the old, crude field-flooding methods. In the Tule Lake Basin, farmers have also been rotating their fallow fields into lake and marsh as part of a U.S. Fish and Wildlife program called Walking Wetlands. The rotation is heralded as good for wildlife and for agriculture: It provides bulrush sanctuary to migratory birds while replenishing the land so that it is more productive when it again goes under cultivation.

Even such mutually beneficial arrangements required a laying down of old suspicions, noted Ron Cole, as he marched with wildlife biologist Dave Mauser through a soon-to-be-flooded field, wearing his Department of the Interior greens. "Years ago, there's no way we would be standing in these uniforms in this private field," he marveled.

For their part, the lower Klamath Indians have had to break out of a tradition of secretiveness—born of the time when they fished and worshipped only at night and spent their days hiding in caves, trying to stay invisible. Now they must join in a boisterous debate with people they've never been able to trust. "In my mind that's the very thing that saved us, our ability to blend in. But now that strategy has to change," Leaf Hillman explained, "because if we continue to blend in and not be noticed, that will spell our doom."

Meanwhile, the farmers upstream are sounding like nothing so much as World Renewal converts, proselytizing the community of all nature. "As a man of faith," Steve Kandra said, "I think the water crisis was God saying you guys gotta figure it out, because you're related to each other. You guys better figure it out. Well, us folks that are here on the ground, we're working darn hard to save these communities. I don't think anyone is going to accept elimination of one community over the other."

"What I think has evolved is that people are looking out for the other guy's back, not just their own anymore," Ron Cole observed. "Just a little. The families up here, they never felt connected with this river. Now they do. They feel they're river people too." □

Amish mantle and miracle invention help home heat bills hit rock bottom

Miracle heaters being given away free with orders for real Amish fireplace mantles to announce the invention that help slash heat bills, but Amish craftsmen under strain of Christmas rush forces household limit of 2

Save money: only uses about 8¢ electric an hour; so turn down your thermostat and never be cold again

By Mark Woods
Universal Media Syndicate

■ **GENUINE AMISH MANTLES MADE IN THE USA:** Everyone wants to save money on heat bills this winter, so entire Amish communities are working from the crack of dawn to finish. These fine real wood Amish made fireplace mantles are built to last forever. The oak mantle is a real steal at just two hundred ninety-eight dollars because all those who beat the order deadline by calling the National Hotline at 1-800-918-4312 to order the fireplace mantles are actually getting the imported hi-tech Fireless Flame HEAT SURGE miracle heaters for free.

(UMS) Everyone hates high heat bills. But we're all sick and tired of simply turning down the thermostat and then being cold.

Well now, the popular HEAT SURGE® miracle heaters are actually being given away free to the general public for the next 7 days starting at precisely 8:00 a.m. today.

The only thing readers have to do is call the National Distribution Hotline before the 7-day deadline with their order for the handmade Amish Fireplace Mantle. Everyone who does is instantly being awarded the miracle heater absolutely free.

This is all happening to announce the HEAT SURGE Roll-n-Glow® Fireplace which actually rolls from room-to-room so you can turn down your thermostat and take the heat with you anywhere. That way, everyone who gets them first can immediately start saving on their heat bills.

Just in time for winter weather, portable Amish encased fireplaces are being delivered directly to the doors of all those who beat the deadline.

These remarkable fireplaces are being called a miracle because they have what's being called the 'Fireless Flame' patented technology that gives you the peaceful flicker of a real fire but without any flames, fumes, smells, ashes or mess. Everyone is getting them because they require no chimney and no vent. You just plug them in.

The Fireless Flame looks so real it amazes everybody because it has no real fire. So what's the catch? Well, soft spoken Amish craftsmen who take their time hand building the mantles have a process that forces a strict household limit of 2 to keep up with orders.

"We can barely keep up ever since we started giving heaters away free. With winter just around the corner, everyone's trying to get them. Amish craftsmen are working their fingers to the bone to be sure everyone gets their delivery in time for Christmas," confirms Timothy Milton, National Shipping Director.

"These portable Roll-n-Glow Fireplaces are the latest home decorating sensation. They actually give you a beautifully redecorated room while they quickly heat from wall to wall. It's the best way to dress up every room, stay really warm and slash your heat bills all at the same time," says Josette Holland, Home Makeover Expert.

And here's the best part. Readers who beat the 7-day order deadline are getting their imported hi-tech miracle heaters free when encased in the Amish built real wood fireplace mantles. The mantles are being handmade in the USA right in the heart of Amish country where they are beautifully hand-rubbed, stained and varnished.

You just can't find custom made Amish mantles like this in the national chain stores. That makes the oak mantle a real steal for just two hundred ninety-eight dollars since the entire cost of the miracle heater is free.

This free giveaway is the best way to slash heating bills and stay warm this fall and winter. The HEAT SURGE Roll-n-Glow Fireplace gives you zone heating and all the

ADVERTISEMENT

HEAT SURGE® *Fireless* Flame

How It Works: The HEAT SURGE miracle heater is a work of engineering genius from the China coast so advanced, you simply plug it into any standard wall outlet. It uses only about 8¢ of electric an hour. Yet, it produces up to an amazing 5,119 BTU's. An on board Powerful hi-tech heat turbine silently forces hot air out into the room so you feel the bone soothing heat instantly. It even has certification of Underwriters Laboratories coveted UL listing. It also comes with a limited full year replacement or money back warranty plus a 30-Day Satisfaction Guarantee.

UL LISTED

How to get 2 free heaters

The National Toll Free Hotlines are now open. All those who beat the 7-day order deadline to cover the cost of the Amish made Fireplace Mantle and shipping get the HEAT SURGE miracle heater free.

A strict limit of 2 per household has been imposed. Since some home woodworkers want to build their own mantle piece, they are letting people get the imported miracle heater alone for just $249. Or, with the Amish made mantle you get the miracle heater free.

Use the map below to locate the weather zone you live in and call the Hotline number for your zone.

Claim Code: FP5667

■ **ON THEIR WAY:** Christmas orders have turned country roads into pipelines to the big city delivery system. Everybody wants a fireplace that comes fully assembled with a handmade Amish mantle in oak or cherry finish and gets delivered by truck right to your door. All you do is plug it in.

EVERYONE LIVING IN THE Frigid Zone: 1
START CALLING AT 8:00 A.M. TODAY
1-800-918-4312

EVERYONE LIVING IN THE Cold Zone: 2
START CALLING AT 8:30 A.M. TODAY
1-800-716-2513

EVERYONE LIVING IN THE Frost Zone: 3
START CALLING AT 9:00 A.M. TODAY
1-800-695-3077

FOR HEAT SURGE, LLC 3939 EVERHARD RD., CANTON OH 44709

beauty and warmth of a built-in fireplace but rolls from room-to-room so it can also save you a ton of money on heating bills.

Even people in California and Florida are flocking to get them so they may never have to turn on their furnace all winter. And since it uses only about 8 cents of electric an hour the potential savings are absolutely incredible.

"We are making sure no one gets left out, but you better hurry because entire communities of Amish craftsmen are straining to keep up with demands. For now, we are turning away all dealers in order to let readers have two per household just as long as they call before the deadline," confirms Milton.

It's a really smart decision to get two right now because for only the next 7 days you get both miracle heaters free. That's like putting five hundred bucks right in your pocket and you can save even more money on your monthly heating bills.

"Everyone's calling to get one but those who are getting their Christmas shopping done early are surprising the whole family by getting two. So when lines are busy keep trying or log onto amishfireplaces.com. We promise to get to every call. Then we can have a delivery truck out to your door right away with your beautiful Heat Surge Roll-n-Glow Fireplace," Milton said.

"You'll instantly feel bone soothing heat in any room. You will never have to be cold again," he said. ■

On the worldwide web:
www.amishfireplaces.com

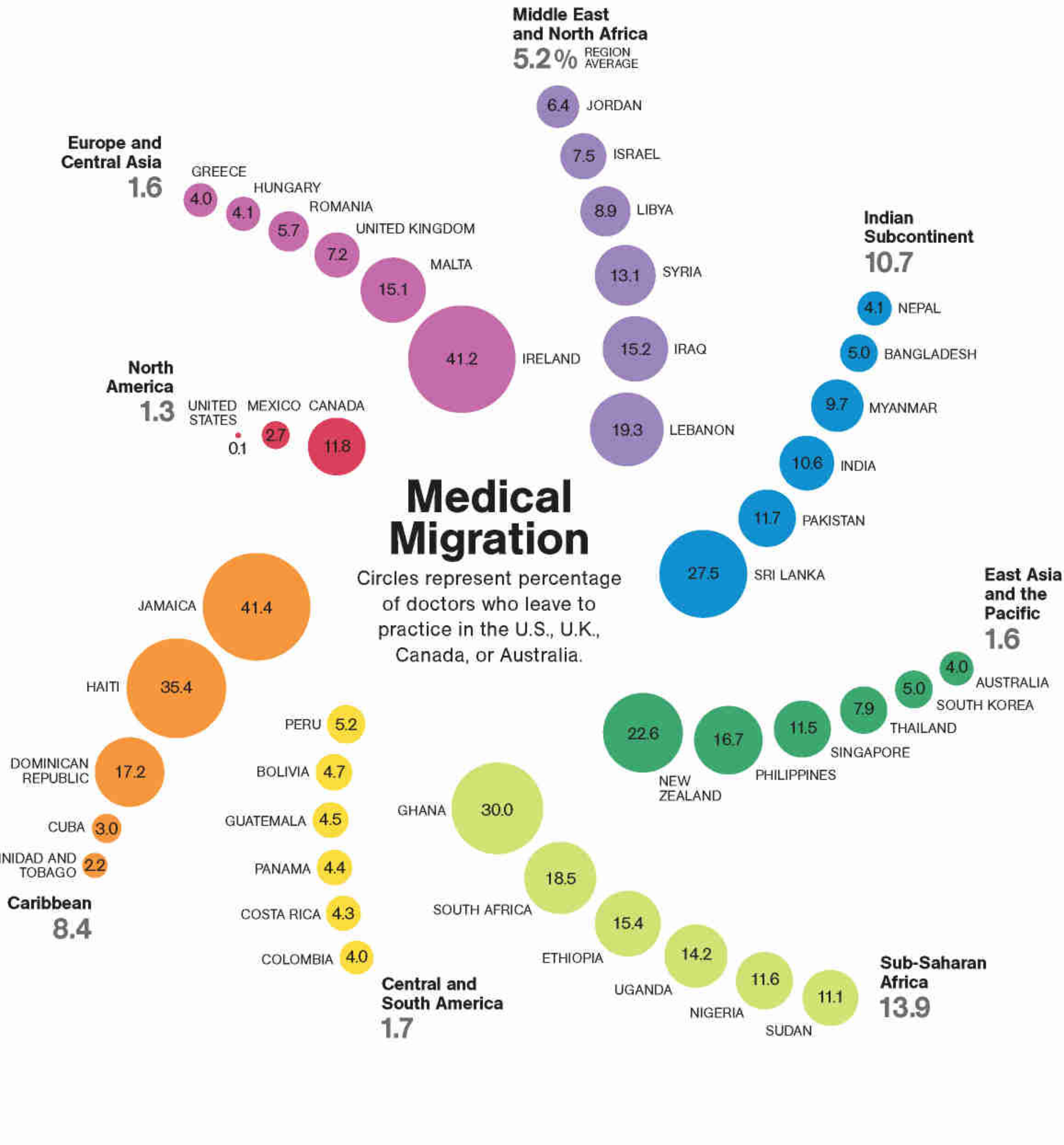
Rolls anywhere to throw an instant heat wave with no chimney, no vents, no wood and no smoke

■ **EASILY ROLLS ANYWHERE:** This is the portable Roll-n-Glow® Fireplace that easily rolls from bedroom to living room to keep you warm. No vents, no chimney and no tools. Just plug it in.

■ **SAVES ON BILLS:** Everyone can get low bills and stay warm and cozy. The new Roll-n-Glow Fireplace saves a ton of money and makes your front room look like a million bucks.

■ **SAFE:** The Fireless Flame looks so real it fools every body but there is no real fire. That makes the flame safe to the touch. It's where the kids will play and the cat and dog will sleep.

■ **FREE:** Get this $249 miracle heater free. It is being given away free to all who beat the 7-day order deadline for your choice of the oak or cherry finish Amish Mantles. The free heater comes already encased.



Recipient Country	Total No. of IMGs*	Percent of Doctors
U.S.	208,733	25.0
U.K.	39,266	28.3
Canada	15,701	23.1
Australia	14,346	26.5

*INTERNATIONAL MEDICAL GRADUATES

The world is facing a critical shortage of doctors, and the prognosis is getting worse. The United States, the United Kingdom, Canada, and Australia are all struggling to meet their populations' health care challenges. Unfortunately for much of the developing world, wealthy nations are drawing doctors from countries where the need for medical professionals is especially urgent. Restrictions to limit brain drain are often ineffective. Better hope may lie with Western investment. New York's Weill Cornell Medical College helps train medical students at the Weill Bugando University College in Mwanza, Tanzania—a nation where there is one doctor for every 29,000 people. The program's first ten new Tanzanian doctors graduated in November. *—Margaret G. Zackowitz*

GRAPHIC: MOLLIE BATES, NG STAFF
SOURCE: 2005 STUDY BY FITZHUGH MULLAN, GEORGE WASHINGTON UNIVERSITY SCHOOL OF PUBLIC HEALTH AND HEALTH SERVICES

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National Geographic Society programs support scientific research, geographic exploration, and environmental conservation around the globe.

In a lush island forest, French entomologist Christine Rollard uses a length of rubber tubing to collect spiders too delicate to grasp with her fingers.

VANUATU **Island Abundance** Even in what seems the middle of nowhere, scientists can—and do—find a breathtaking array of life. During a five-month survey on Vanuatu's island of Espiritu Santo, more than 150 botanists, marine zoologists, and other experts fanned out to scour mountains, forests, caves, reefs, and ocean for living organisms. The international team came up with more than 10,000 species, including crustaceans, insects, plants, and even a glow-in-the-dark fungus. Some 2,000 of these may be new to science. The discoveries will provide a benchmark for measuring future change in a little-known part of the world. Beyond this, "80 percent of the world's species remain to be discovered," says French mollusk expert Philippe Bouchet, one of the expedition leaders. At a time when concern often focuses on what the world is losing, it's a reminder of all that's still to be found.

UNITED STATES
Zoologist **Martin Wikelski** tags bumblebees with tiny radio transmitters. Identifying their flight paths may lead to a better understanding of why honeybees—their relatives—are declining.

SOUTH PACIFIC
Some 3,800 World War II shipwrecks rest on the Pacific Ocean floor, threatening marine ecosystems such as coral reefs with oil spills and live ammunition. Conservationist **Michael Barrett** is mapping their locations. His next step is a cleanup.

RUSSIA AND ICELAND
Geologist **Michael Ramsey** uses infrared images to examine heat patterns on potentially deadly volcanoes. His research may help forecast eruptions and avert tragedy.

ALASKA
The 425-million-year-old spiny whirlpool snail (right) discovered by geologist **David Rohr** is unrelated to North America's prehistoric fauna. It's linked to Siberia and the Urals, suggesting that Alaska is a mosaic of fragments of other continents.

This Year in NGS History

1960

Deep-sea explorer **Jacques-Yves Cousteau** pioneered the use of a "diving saucer" with NGS support. The submersible let him be the first to explore the oceans' continental shelves.

Find more at **nationalgeographic.com/news.**

PHOTOS: XAVIER DESMIER, GAMMA/EYEDEA (LEFT); DAVID ROHR

INSIDE GEOGRAPHIC

At a museum curator's house in a London suburb, Robert Clark came nose to antenna with Sheila, a pet rhinoceros cockroach.

ON ASSIGNMENT **Guiding Hand** After seeing dozens of the man's specimens up close, photographer Robert Clark knows this: Naturalist Alfred Russel Wallace had great handwriting. It was certainly better than that of another guy who studied evolution. "You can't even read Darwin's letters," Clark says. "They're practically illegible."

For this issue's "The Man Who Wasn't Darwin," Clark photographed animals Wallace collected—most with handwritten labels still attached—at London's Natural History Museum.

Clark's guide to the world of Wallace was George Beccaloni, who happens to be the museum's curator of cockroaches. Beccaloni calls himself "Wallace's rottweiler." He's championed the naturalist's work and even raised money to restore the naturalist's grave, which until recently was neglected and overgrown. "George is exactly who you hope you'd meet when you get an assignment like this," says Clark. "He has a lot of information, and he's sweet." Clark also met Beccaloni's cockroaches (above); they fill tanks in a spare room.

PEOPLE BEHIND THE STORIES

Tina Rosenberg

Drawn mainly from the Untouchable castes, illiterate health workers are transforming rural India. While reporting their remarkable story for this issue's "Necessary Angels," Rosenberg, a Pulitzer Prize winner, confronted a nadir of poverty. "I'd interviewed the poor in Latin America, Africa, and East Asia," she says. "I thought I knew what misery was. But in parts of India, even those who consider themselves relatively prosperous are miserably poor. One woman lives in a windowless hut with a tin roof held down by tires and pots. She hangs her clothes on a rope, sleeps on a mat, and cooks over a twig fire outside. And she's her village's leader."

David Quammen

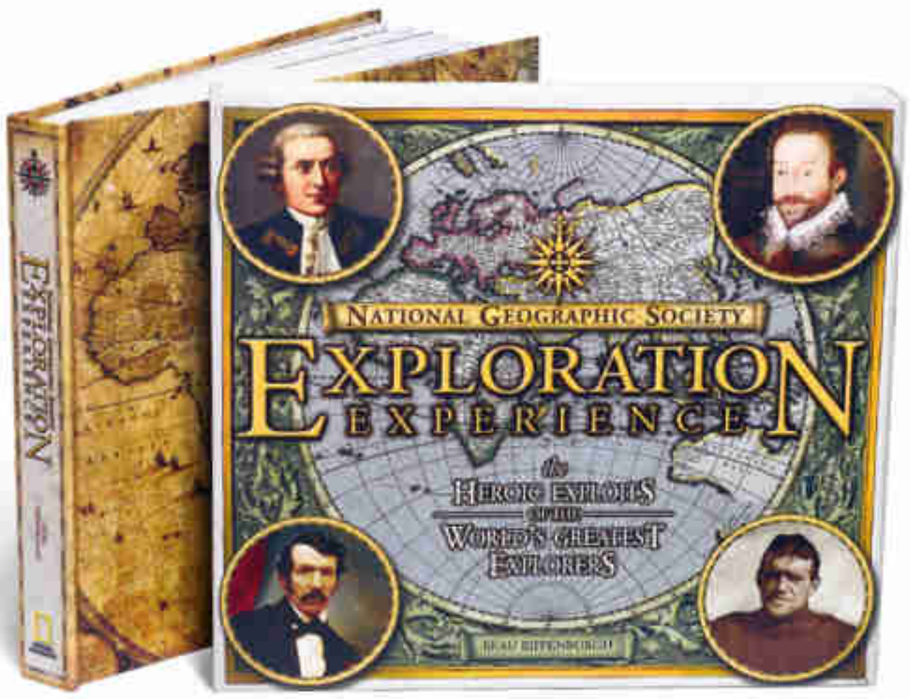
For this issue's "The Man Who Wasn't Darwin," Quammen, a *Geographic* contributing writer, traced the travels of English naturalist Alfred Russel Wallace. Recalling his own time in Indonesia, when he was startled by one of Komodo's namesake dragons, Quammen is puzzled by a lizard-size hole in Wallace's seminal text. "Given that Wallace was in the region for eight years—sailing among the islands, looking for amazing fauna, passing by Komodo—why did he never catch wind of the Komodo dragon's existence? There's no mention of it in *The Malay Archipelago*."

PHOTOS (CLOCKWISE FROM TOP): DAVID COVENTRY; REBECCA HALE, NG STAFF; LYNN DONALDSON

INSIDE GEOGRAPHIC

Archaeologist Ehud Netzer stands atop the base of Herod's tomb, in Israel.

NG CHANNEL **On Herod's Trail** Two thousand years after King Herod's death, the places he built are still landmarks in Israel, including Jerusalem's Western Wall and Masada. *Herod's Lost Tomb*, airing November 23 at 9 p.m. on the National Geographic Channel, explores these royal sites and uses computer graphics to show how the structures might have looked when they were new.



NG BOOKS **To the Ends of the Earth** Handle a bit of history with the *National Geographic Society Exploration Experience.* Reproductions of historic documents are inserted in envelopes throughout the book, which covers everything from 15th-century Portuguese sailors to polar treks of the 20th century. One highlight is a menu from a 1914 dinner in London; Ernest Shackleton used a blank page to draw a map of Antarctica to show his neighbor his planned route across the continent. *National Geographic Society Exploration Experience* is in bookstores now ($50).

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PHOTO: MICHAEL MELFORD

Nel Cepeda

Pat Minnick included National Geographic in her financial plans.

Give An Inspiring Gift

In 2007 Pat Minnick, a professional artist, decided to establish a charitable gift annuity to support National Geographic. She now receives a guaranteed life income and is a direct part of the Society's efforts to inspire people to care about the planet.

"I feel good knowing that National Geographic is doing so much to protect endangered wildlife," says Pat. "The environmental problems we face are vast, but by joining with National Geographic and their history of remarkable accomplishments, I know we can pass on a more beautiful world."

For more information about a charitable gift annuity or other ways to include National Geographic in your estate plans, please contact the Office of Gift Planning.

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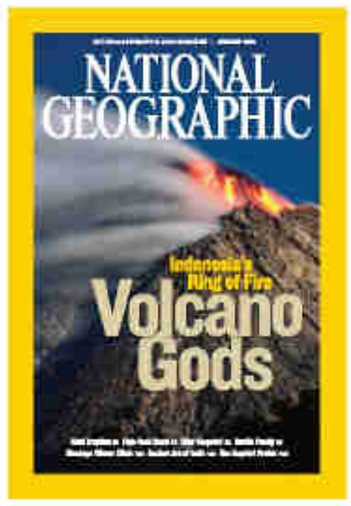

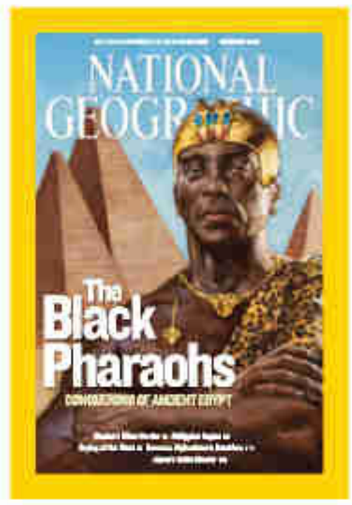

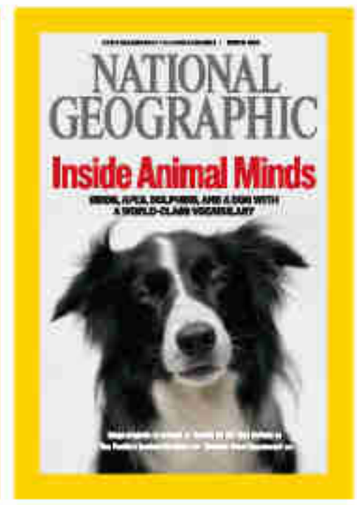

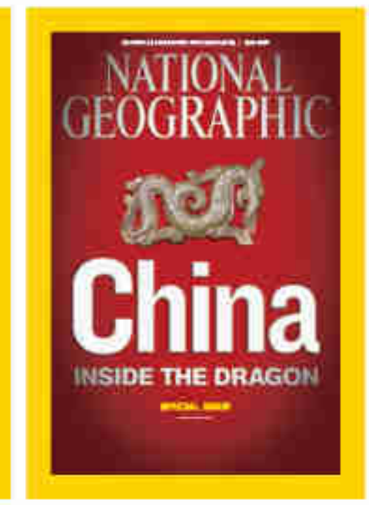

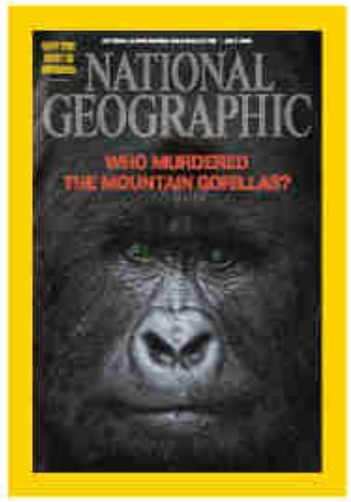

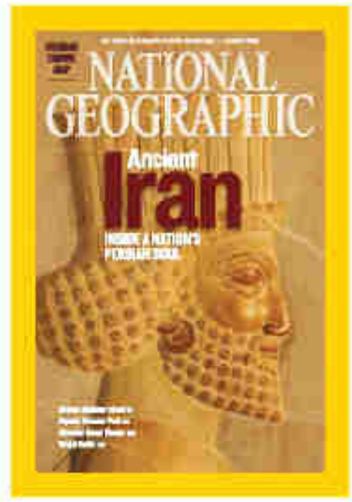

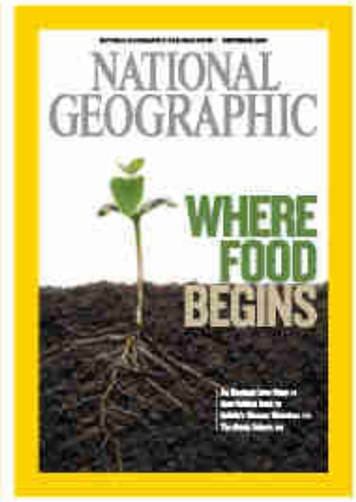

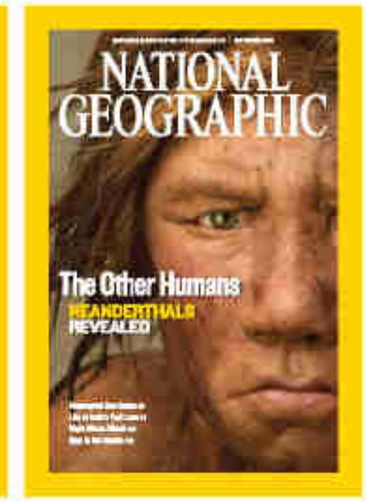

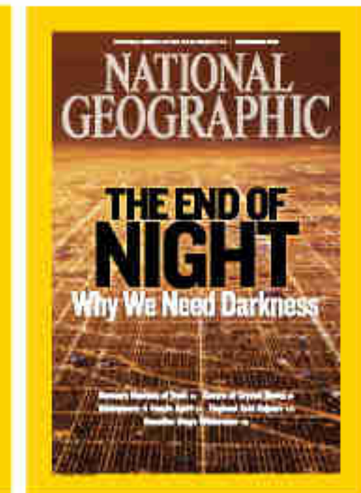

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FLASHBACK

Blanket Statement "According to native superstition, the cure for erysipelas [a bacterial skin infection] is to kill a pig, cut it open, and put the sufferer inside," noted Willard Price about this photograph, which he shot for an article he wrote on Korea for the October 1945 *Geographic*. However, Price explained, "Dr. J. M. Rogers of the Southern Presbyterian hospital, Suncheon, advises a somewhat different treatment." *—Margaret G. Zackowitz*

Flashback Archive Find all the photos at **ngm.com.**

PHOTO: WILLARD PRICE, NATIONAL GEOGRAPHIC STOCK

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